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FORMULATION AND EVALUATION OF HERBAL SYRUP CONTAINING *PHYLLANTHUS NIRURI* (KEEZHANELLI) USING MACERATION TECHNIQUE

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ABSTRACT

The present study focuses on the formulation and evaluation of a herbal syrup prepared from *Phyllanthus niruri* (Keezhanelli), a medicinal plant widely used in traditional systems. The plant material was collected, authenticated, processed, and subjected to extraction using the maceration method. The syrup was formulated using suitable excipients such as stevia, citric acid, sodium benzoate, glycerin, propylene glycol, and Tween 80 to enhance palatability, stability, and bioavailability. The prepared formulation was evaluated for organoleptic, physicochemical, and stability parameters. The results indicated that the syrup possessed desirable characteristics including acceptable pH, viscosity, and stability without any significant changes during storage. The study confirms the successful formulation of a stable and effective herbal syrup.

KEYWORDS: *Phyllanthus niruri*, Keezhanelli, Herbal syrup, Maceration, Formulation, Evaluation, Flavonoids, Stability studies.

1. INTRODUCTION

Menstrual disorders such as excessive bleeding (menorrhagia) and irregular cycles are common problems affecting women of reproductive age. Conventional treatments often rely on hormonal therapies or synthetic drugs, which may cause side effects with long-term use. Therefore, herbal formulations are gaining importance due to their safety, efficacy, and minimal adverse reactions. Keezhanelli (*Phyllanthus niruri* L.), a well-known medicinal herb in traditional systems such as Siddha and Ayurveda, has been widely used for its hepatoprotective, anti-inflammatory, antioxidant, and diuretic properties. In addition to its known therapeutic roles, Keezhanelli has been traditionally used to regulate menstrual flow and alleviate uterine disorders.

Formulating Keezhanelli as a herbal syrup offers a convenient and palatable dosage form that ensures better patient compliance and faster absorption. The phytochemical constituents such as flavonoids, lignans, tannins, and alkaloids present in Keezhanelli are believed to help in balancing hormonal levels, reducing uterine inflammation, and controlling excessive menstrual bleeding. Hence, the development and evaluation of Keezhanelli syrup aim to provide an effective, natural, and affordable herbal remedy for managing menstrual bleeding disorders and improving women's reproductive health.



Fig 1: Keezhanelli Syrup.

Liquid dosage forms are pharmaceutical preparations in which active drug ingredients are dissolved, suspended, or emulsified in a suitable liquid vehicle. They are intended for oral, parenteral, or topical administration and are among the most commonly used dosage forms

due to their ease of swallowing, rapid absorption, and flexible dosing. Liquid preparations are particularly beneficial for pediatric, geriatric, and dysphagic patients, as they eliminate the difficulty of swallowing solid forms such as tablets or capsules. They also allow for uniform distribution of active ingredients, enabling accurate dose adjustment according to patient needs.

Common types of liquid dosage forms include solutions, suspensions, emulsions, syrups, elixirs, tinctures, and drops. Each type is formulated with suitable excipients like solvents, stabilizers, sweeteners, flavoring agents, preservatives, and viscosity enhancers to ensure stability, palatability, and therapeutic efficacy. However, liquid formulations also present challenges such as microbial contamination, physical and chemical instability, and the need for accurate measurement during administration. Proper formulation design, selection of suitable excipients, and use of preservatives are essential to maintain product quality and extend shelf life.

A syrup is a sweet, viscous liquid dosage form that contains one or more medicinal substances dissolved in a concentrated solution of sugar, usually sucrose, in water. Syrups are one of the most popular oral liquid dosage forms, especially for pediatric and geriatric patients, because they are easy to swallow and have an agreeable taste.

1.1 Characteristics

- ❖ Viscous and sweet in nature.
- ❖ Water-based preparation.
- ❖ It can be medicated (contains active drug) or non-medicated (used as a vehicle).
- ❖ Pleasant taste and mask bitterness of drugs.
- ❖ Used for oral administration.

1.2 Advantages

- ❖ Improves patient compliance due to sweetness.
- ❖ Easily administered to children and elderly.
- ❖ Quick absorption compared to solid dosage forms.
- ❖ Can mask unpleasant taste or odour of drugs.

1.3 Types of Syrups

- ❖ **Medicated Syrups** – Contain therapeutic agents (e.g., Cough syrup, Iron syrup).

- ❖ **Non-medicated Syrups** – Used as flavouring or vehicles (e.g., Simple syrup).
- ❖ **Flavoured Syrups** – Contain flavouring agents like orange or vanilla.
- ❖ **Artificial Syrups** – Use non-sugar sweeteners for diabetic patients.

1.4 Composition of Syrup

A syrup mainly consists of several key components that together make the formulation stable, effective, and palatable. The typical composition includes:

- ❖ **Vehicle (Base):** Water is the main solvent used to dissolve sugar and other ingredients. It provides the liquid medium for the syrup.
- ❖ **Sweetening Agent:** Usually sucrose (60–70%) is used to give sweetness and viscosity. Other substitutes such as glucose, sorbitol, glycerin, or artificial sweeteners (for diabetic patients). Also acts as a preservative by preventing microbial growth due to high osmotic pressure.
- ❖ **Medicinal Agent:** The active pharmaceutical ingredient (API) that provides the therapeutic effect. Example: Paracetamol, Diphenhydramine, Iron, etc.
- ❖ **Flavouring Agent:** Added to improve taste and acceptability, especially for pediatric use. Examples: Orange, Vanilla, Cherry, Mint, Strawberry.
- ❖ **Colouring Agent:** Used to give an appealing appearance and match the flavour. Example: Caramel, Tartrazine, Erythrosine.
- ❖ **Preservatives:** Prevent microbial growth and increase shelf life. Examples: Sodium benzoate, Benzoic acid, Methyl paraben, Propyl paraben.
- ❖ **Stabilizers / Buffering Agents:** Maintain pH and stability of the formulation. Examples: Citric acid, Sodium citrate.
- ❖ **Thickening or Viscosity Agents (Optional):** Used to improve the texture and mouth feel. Examples: Glycerin, Sorbitol, Xanthan gum.

2. PLANT & DISEASE PROFILE

2.1 Synonyms

- ❖ *Phyllanthus fraternus* G.L. Webster
- ❖ *Phyllanthus kirganelia*
- ❖ *Phyllanthus urinaria* var. *niruri*
- ❖ *Diasperus niruri* (L.) Kuntze

2.2 Biological Source

- ❖ The crude drug Keezhanelli consists of the whole plant of *Phyllanthus niruri* Linn.

2.3 Family

- ❖ Phyllanthaceae (formerly Euphorbiaceae)

2.4 Geographical Source

- ❖ Commonly grows in moist, shady areas, roadsides, gardens, and wastelands during the rainy season, widely used in Tamil Nadu, Kerala, Andhra Pradesh, Karnataka, West Bengal.

2.5 Vernacular Names

- ❖ **Common name:** Gale of the wind, Stonebreaker, Seed- under- leaf, and Bhumyamalaki
- ❖ **Tamil:** Keelanelli
- ❖ **Malayalam:** Kizhanelli, Keezhanelli, Kiruthaanelli
- ❖ **Telugu:** Nela Usiri, Nela Usirika
- ❖ **Kannada:** Kiru nelli, Nela nelli, Kirunelli
- ❖ **Hindi:** Bhumi Amla, Jangli amli, Jaramala
- ❖ **Sanskrit:** Bhumiamalaki, Bahupatri

2.6 Taxonomical Classification:

- ❖ **Kingdom:** Plantae
- ❖ **Sub kingdom:** Tracheobionta (Vascular plants)
- ❖ **Superdivision:** Spermatophyta (Seed plants)
- ❖ **Division:** Magnoliophyta (Flowering plants)
- ❖ **Class:** Magnoliopsida (Dicotyledons)
- ❖ **Sub class:** Euphorbiidae
- ❖ **Order:** Malpighiales
- ❖ **Family:** Phyllanthaceae
- ❖ **Genus:** *Phyllanthus*
- ❖ **Species:** *Phyllanthus niruri* L.

2.7 Traditional Uses

- ❖ **Liver health:** Traditionally used to support liver function and treat conditions like jaundice and hepatitis.

- ❖ **Kidney health:** Used as a remedy for kidney stones and other urinary tract issues due to its diuretic properties, which help flush out waste products.
- ❖ **Blood sugar:** Believed to help lower blood sugar levels and improve the lipid profile in people with diabetes.
- ❖ **Digestive health:** Sometimes used to improve digestion and relieve issues like bloating.
- ❖ **Skin conditions:** Applied to treat small wounds, itching, cracked heels, and rashes due to its antimicrobial properties.
- ❖ **Hair growth:** Used in traditional oils to promote hair growth, particularly in cases of male pattern baldness.

2.8 Microscopy of Keezhnelli

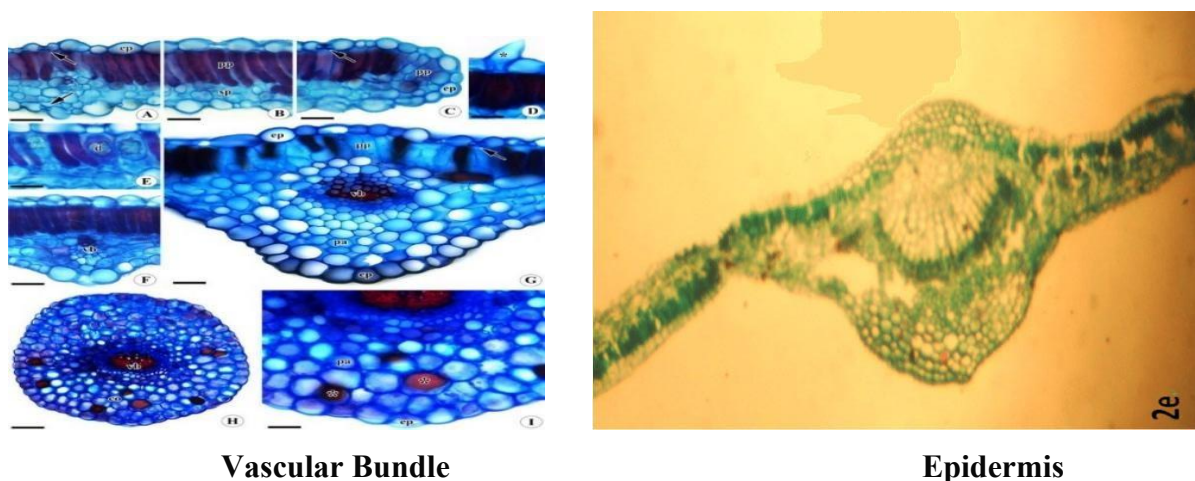


Fig 2: Microscopy.



Fig 3: *Phyllanthus Niruri*.

2.9 Chemical Constituents

- ❖ **Phyllanthin and Hypophyllanthin:** These lignans are considered the primary active compounds in the plant and are valued for their hepatoprotective (liver-protecting) effects.
- ❖ **Flavonoids:** These include compounds such as quercetin and rutin, which are potent antioxidants and possess anti-inflammatory and other protective activities.
- ❖ **Tannins:** These compounds, including corilagin and ellagic acid, contribute to the plant's antioxidant, antiviral, and astringent properties.
- ❖ **Alkaloids:** The alkaloid securinine, and other compounds like nirurin, also play a role in the plant's medicinal effects.
- ❖ **Glycosides:** Glycosides are another class of compounds found in the plant that possess a range of biological activities.

2.10 Menstrual Bleeding By Keezhanelli:

- ❖ Menstrual bleeding refers to the cyclic discharge of blood mucus, and endometrial tissue from the Uterus through the vagina, occurring as per of the menstrual cycle in women of reproductive age.
- ❖ It typically lasts for 3-7days and indicates normal hormonal balance and uterine function.
- ❖ In the context of keezhanelli [*Phyllanthus nirurin*], menstrual bleeding refers to the physiological or pathological uterine bleeding that the herb may help regular to manage. Especially in cases of menorrhagia [excessive bleeding] or irregular menstruation.

2.11 Keezhanelli In Menstrual Bleeding:

- ❖ Keezhanelli possesses anti-inflammatory, antioxidant, and hormone-regulating properties.
- ❖ It is traditionally used in Siddha and Ayurveda to control excessive menstrual bleeding, support liver function, and balance hormones, which play a key role in regulating menstruation.

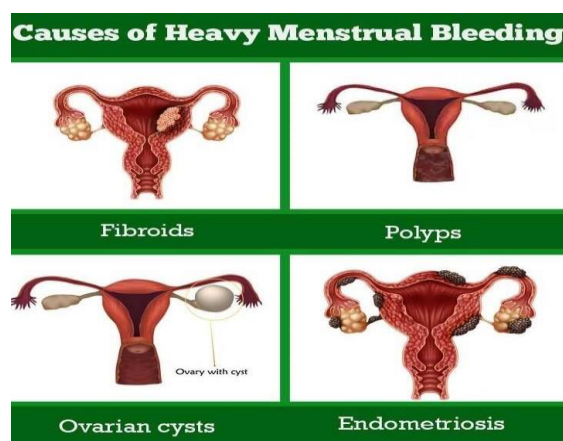


Fig 4: Causes of Heavy Menstrual Bleeding

2.12 Keezhanelli's Role

- ❖ Regulating menstrual flow and reducing excessive bleeding.
- ❖ Supporting liver function, which aids hormone balance.
- ❖ Reducing inflammation and pelvic pain.
- ❖ Improving blood purification and general vitality.

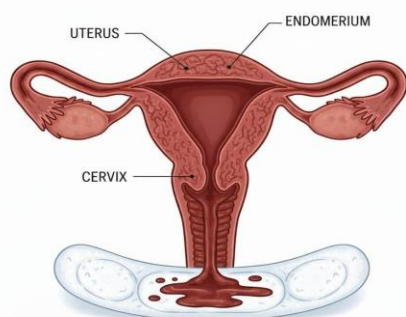
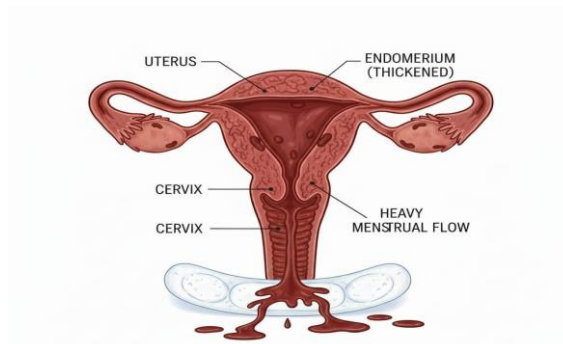
2.13 Risk Factors for Menstrual Bleeding Disorders:

- ❖ **Hormonal Imbalance:** Excess or deficiency of estrogen and progesterone Common during puberty and perimenopause.
- ❖ **Uterine Conditions:** Fibroids (non-cancerous uterine growths). Polyps or endometriosis. Adenomyosis (thickening of uterine wall).
- ❖ **Medical Disorders:** Thyroid dysfunction (hypo/hyperthyroidism) ✓ Liver disease (which affects hormone metabolism). Blood clotting disorders (e.g., von Willebrand disease).
- ❖ **Lifestyle Factors:** Stress and lack of sleep, Poor nutrition or iron deficiency, Obesity or being underweight ✓ Excessive physical activity
- ❖ **Medications and Contraceptives:** Anticoagulants or hormonal birth control misuse. Certain herbal supplements or drugs affecting hormone levels.
- ❖ **Infections or Inflammation:** Pelvic inflammatory disease (PID). Chronic uterine or vaginal infections.

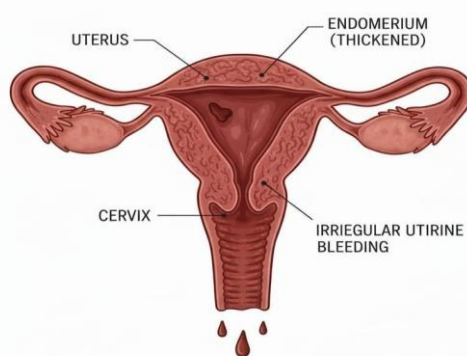
2.14 Keezhanelli's Role in Different Classes:

- ❖ **In Menorrhagia / Metrorrhagia:** Helps reduce excessive bleeding due to its anti-inflammatory and hemostatic effects.

- ❖ **In Oligomenorrhea / Amenorrhea:** Supports hormonal balance and improves menstrual regularity through liver detoxification.
- ❖ **In Dysmenorrhea:** Reduces uterine inflammation and pain.

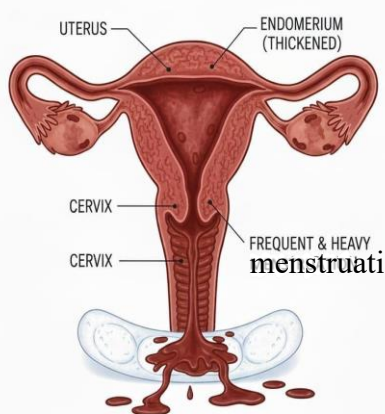


NORMAL MENSTRUAL BLEEDING
Regular and manageable menstrual flow

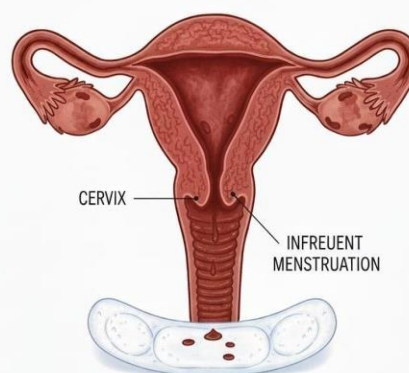


Abnormal Uterine Bleeding (AUB)

Metrorrhagia



Polymenorrhea



Oligomenorrhea

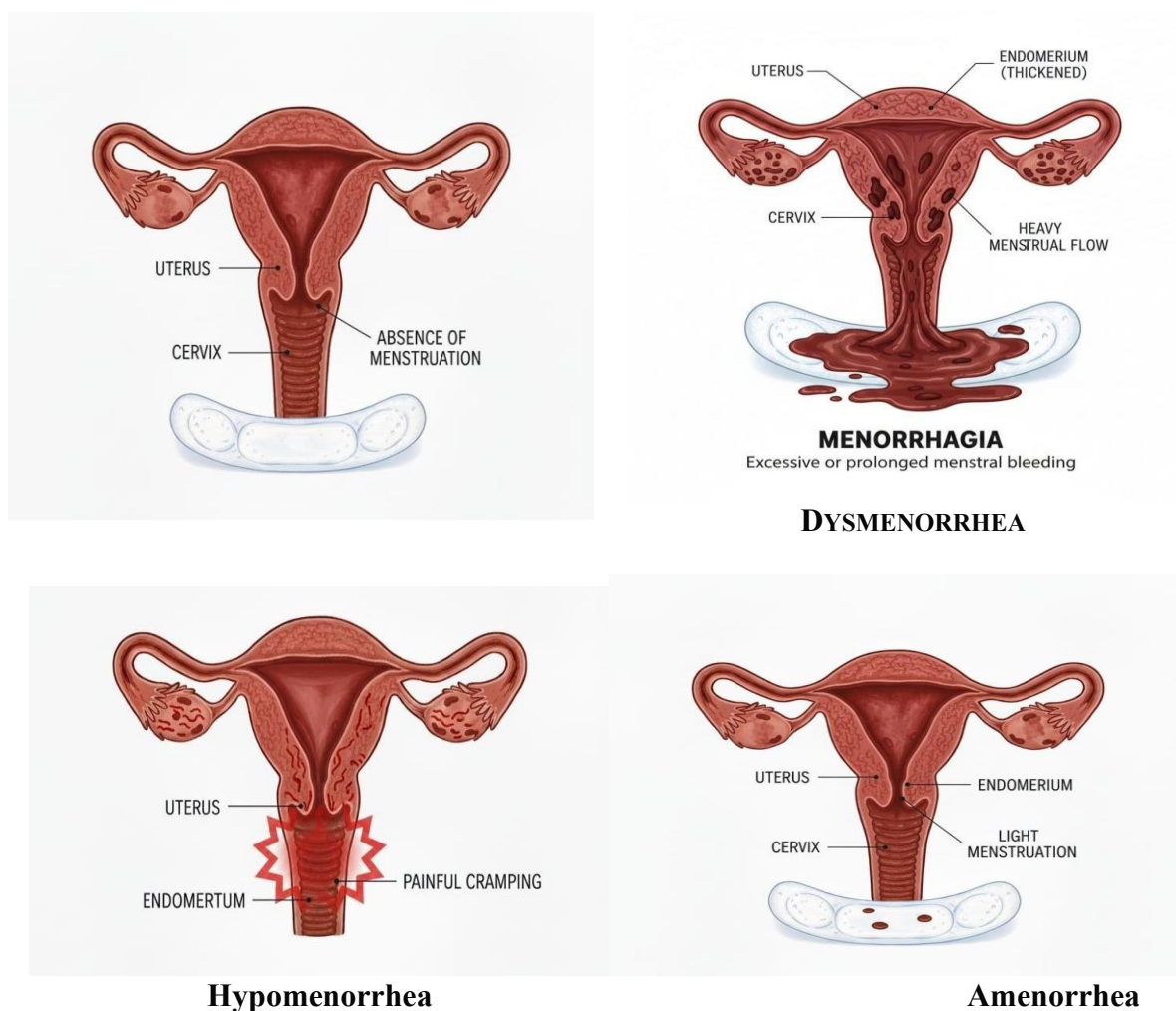


Fig 5: Classification of Menstrual Bleeding Disorders.

2.15 Keezhanelli (*Phyllanthus niruri*) Treatment Role:

- ❖ Property Benefit in Menstrual Disorders
- ❖ Hepatoprotective Regulates hormones by supporting liver function.
- ❖ Anti-inflammatory & Antioxidant Reduces uterine inflammation and pain.
- ❖ Hemostatic Helps control excessive menstrual bleeding.
- ❖ Hormone Balancing Normalizes menstrual cycle irregularities
- ❖ Blood Purifying Improves blood quality and reduces fatigue.

2.16 Keezhanelli (*Phyllanthus niruri*) in Menstrual Disorders:

- ❖ Keezhanelli is widely used in Siddha and Ayurveda for balancing hormones and purifying the blood.
- ❖ Therapeutic Property Effect in Menstrual Disorders.
- ❖ Hepatoprotective improves Liver function, supporting hormonal metabolism.
- ❖ Anti-inflammatory & Antioxidant Reduces uterine inflammation and menstrual pain.

- ❖ Hemostatic Controls excessive bleeding (menorrhagia, metrorrhagia)
- ❖ Hormone Balancing Helps normalize irregular menstrual cycles.
- ❖ Blood Purifying Restores hemoglobin and vitality after prolonged bleeding.

2.17 Expected Benefits of Keezhanelli Treatment:

- ❖ Regulates menstrual cycle
- ❖ Reduces excessive bleeding.
- ❖ Relieves menstrual pain and inflammation.
- ❖ Prevents anemia and fatigue
- ❖ Enhances reproductive health naturally.

3. MATERIALS AND METHODS

3.1 Collection of Plant

Phyllanthus niruri plant were obtained from Rantham village, Tiruvannamalai district, Tamil Nadu, India. It was identified and authenticated national institute of siddha, Tambaram, Chennai 600047. The plant were washed thoroughly with tap water, shade dried and grinded using mortar and pestle. The powder was then stored in an air tight container until further uses.

3.2 List of Chemicals

Table: 1 List of Chemicals.

Ingredients	Properties
Keezhanelli (Phyllanthus niruri Linn.)	Active pharmaceutical ingredient
Purified water	For extraction
Stevia	Sweetening agent
Citric acid	Preservative and Ph adjustment
Sodium benzoate	Preservative
Glycerin	Humectant and Viscosity enhancer
Propylene glycol	Viscosity enhancer
Tween 80	Bioavailability enhancer

3.3 Maceration Method

Maceration is a convenient, simple inexpensive, and favourable technique, especially in the case of small-scale extraction, such as that at laboratory scale. It is based on the induction of the mass transfer with shaking until the solid/liquid equilibrium is reached. this technique usually requires second step for the concentration of the extract. Maceration is also a well-known technique used for the preparation of the tonics. It is carried out in closed vessels with the occasional mixing and involves several consecutive steps: grinding of the plant material,

immersion of grinded material into solvent, removing the solvent, and pressing of the sample in order to recover crude extract. Those steps are performed for: Increasing diffusion of desired compounds from plant material to solvent. Removing concentrated solution from the surface of plant material which actually increases extraction yield.

3.4 Formulation of Syrup

Table: 2 Formulation of Syrup.

S.No	Ingredients	Quantity
1	Keezhanelli (<i>Phyllanthus niruri</i> Linn.)	10ml
2	Stevia	1gm
3	Citric acid	1gm
4	Sodium benzoate	0.5gm
5	Glycerin	15ml
6	Propylene glycol	10ml
7	Tween 80	5ml
8	Purified water	Up to 100ml

Procedure

The formulation is prepared by first taking about 60–70 ml of purified water in a clean beaker, in which stevia (1 g) and citric acid (1 g) are dissolved with continuous stirring until a clear solution is obtained. To this, sodium benzoate (0.5 g) is added and mixed well until completely dissolved. In a separate beaker, glycerin (15 ml), propylene glycol (10 ml), and Tween 80 (5 ml) are mixed together to form a uniform solvent phase. The Keezhanelli extract (*Phyllanthus niruri* Linn.) (10 ml) is then added slowly to this mixture and stirred thoroughly to ensure proper dispersion. This solvent phase is gradually incorporated into the aqueous phase with continuous stirring to obtain a homogeneous mixture. Finally, purified water is added to make up the total volume to 100 ml, and the preparation is mixed well. If necessary, the solution is filtered to remove any undissolved particles and then transferred into a clean, airtight container for storage.

3.5 Evaluation of Keezhanelli Syrup:

The prepared Keezhanelli syrup was evaluated for various organoleptic, physicochemical, and stability parameters to ensure its quality, safety, and efficacy.

❖ **Organoleptic Evaluation:** The syrup was evaluated for colour, odour, taste, and appearance by visual inspection. The formulation showed a characteristic dark brown colour, pleasant herbal odour, sweet taste, and clear, homogeneous appearance without suspended particles.

❖ **pH Determination:** The pH of the syrup was measured using a calibrated digital pH meter at room temperature. The pH was found to be within the acceptable range for oral herbal syrups.

❖ **Viscosity:** The viscosity of the syrup was determined using a Brookfield viscometer to ensure uniform flow and pourability. The viscosity value indicated appropriate syrupy consistency.

❖ **Specific Gravity:** Specific gravity was determined using a pycnometer to assess the density of the syrup. The values obtained confirmed uniformity of the formulation.

❖ **Stability Studies:** Stability studies were carried out by storing the syrup at room temperature and observing changes in colour, pH, precipitation, and microbial growth over a specific period. The formulation remained stable with no significant changes.

4. RESULTS AND DISCUSSION

4.1 Evaluation of Herbal Syrup

Table: 3 Evaluation of Herbal Syrup.

S. No	Parameter	Method/Observation	Result
1	Organoleptic properties	Visual inspection (colour, odour, taste, appearance)	Dark brown colour, pleasant odour, sweet taste, clear and homogeneous
2	pH	Digital pH meter	6.2
3	Viscosity	Ostwald viscometer	850 cps
4	Specific Gravity	Pycnometer	1.18
5	Stability Studies	Storage at room temperature for 30 days	No change in colour, pH (6.1–6.3), no precipitation, stable

4.2 Chemical Test

1. Flavonoids (Alkaline Reagent Test): Alkaline Reagent test produces an intense yellow colour that turns colourless upon adding acid, confirming the presence of flavonoid compounds in plant extracts.

2. Tannins (Ferric Chloride Test): Add 2–3 drops of 10% ferric chloride solution FeCl_3 to the aqueous extract.



Fig 6: Maceration Extract.



Fig 7: Keezhanelli Syrup.



Fig 8: Chemical Test.



Fig 9: Viscosity.



Fig10: pH.

DISCUSSION

The formulation of Keezhanelli syrup was carried out using the maceration method, which is a simple and cost-effective extraction technique suitable for laboratory-scale preparations. This method facilitated efficient extraction of active constituents by enhancing solvent penetration and diffusion. The selected excipients played crucial roles in the formulation. Stevia acted as a natural sweetening agent, improving patient compliance, while citric acid maintained pH and functioned as a preservative. Sodium benzoate further enhanced microbial stability. Glycerin and propylene glycol contributed to viscosity and uniform consistency, whereas Tween 80 improved the bioavailability of active compounds.

Evaluation studies demonstrated that the syrup had a dark brown colour, pleasant odour, and acceptable taste, indicating good organoleptic properties. The pH (6.2) was within a suitable range for oral administration, ensuring safety and compatibility. Viscosity (850 cps) confirmed appropriate flow properties, and specific gravity (1.18) indicated uniform density. Stability studies conducted over 30 days revealed no significant changes in colour, pH, or precipitation, confirming the formulation's stability. Chemical tests confirmed the presence of flavonoids and tannins, which are responsible for the therapeutic activity of the plant.

5. CONCLUSION

The present work demonstrates that an effective and stable herbal syrup of *Phyllanthus niruri* can be successfully formulated using the maceration technique. The formulation exhibited satisfactory physicochemical properties and stability, making it suitable for oral administration. This herbal syrup could serve as a promising natural therapeutic preparation, and further studies may be conducted to evaluate its clinical efficacy and pharmacological activities.

6. REFERENCES

1. Bagalkotkar, G., Sagineedu, S. R., Saad, M. S., & Stanslas, J. (2006). Phytochemicals from *Phyllanthus niruri* Linn. and their pharmacological properties: a review. *Journal of Pharmacy and Pharmacology*.
2. Boim, M. A., Heilberg, I. P., & Schor, N. (2010). *Phyllanthus niruri* as a promising alternative treatment for nephrolithiasis. *International Braz J Urol*.
3. Chatterjee, M., & Sil, P. C. (2007). Hepatoprotective properties of *Phyllanthus niruri* against carbon tetrachloride-induced hepatic damage in rats: A dose-dependent study. *Journal of Ethnopharmacology*.

4. Dahanayake, J. M., Perera, P. K., Galappaththy, P., & Arawwawala, M. (2020). A mini review on therapeutic potentials of *Phyllanthus niruri* L. Trends in Phytochemical Research.
5. Damasak, A. A., Mahmud, M. A., Daja, A., Isa, M. A., Yakubu, M., Burah, B., & Abba, Y. S. (2023). Phytochemical components and in vitro antioxidant activity of methanol leaves extract of *Phyllanthus niruri* Linn. (Chanca piedra). Arid-Zone Journal of Basic and Applied Research.
6. Dantala, A. T., Naman, K., & Sanda, L. (2022). Therapeutic activity of aqueous leaf extract of *Phyllanthus niruri* against *Plasmodium falciparum*. FUDMA Journal of Sciences.
7. Phytochemical, pharmacological potential and ethnomedicinal... (IJSRA, 2022)
8. An insight into the potent medicinal plant *Phyllanthus amarus* Schum... (PMC, 2022)
9. *Phyllanthus niruri*: A Review on its Ethno Botanical, Phytochemical...(ResearchGate, 2012)
10. (PDF) *Phyllanthus amarus* Lin. Schum. & Thonn: A critical review... (ResearchGate, 2021)
11. *Phyllanthus amarus* - an overview (Science Direct Topics)
12. Standard purity and extractive value criteria for *Phyllanthus niruri*.globinmed.com
13. Qualitative phytochemical constituents (flavonoids, alkaloids, tannins, saponins) in extracts.
14. Metabolite profiling identifying specific compounds (lignans, phenolic acids). PubMed
15. FTIR and GC-MS functional group and compound analysis. afjbs.com
16. Nisar, M. F., He, J., Ahmed, A., Yang, Y., Li, M., & Wan, C. (2018). Chemical components and biological activities of the genus *Phyllanthus*: A review of the recent literature. Molecules.
17. Oliveira, K. G. N., Ferreira, J. P. G., & Moreira, R. F. A. (2023). Total content of phenolic compounds and antioxidant activity of commercial *Phyllanthus niruri* infusions.
18. Akinmoladun, F. O., Komolafe, T. R., Olaleye, T. M., Komolafe, O. O., Farombi, E. O., & Komolafe, T. R. (2018). Antioxidant and hepatoprotective potential of flavonoids: Current evidence and future perspectives. Journal of Food Biochemistry.
19. Anonymous (2017). *Phyllanthus niruri* standardized extract alleviates the progression of non-alcoholic fatty liver disease and decreases atherosclerotic risk in Sprague–Dawley rats. [Journal Article].

20. Atanasov, A. G., Zotchev, S. B., Dirsch, V. M., Supuran, C. T., & International Natural Product Sciences Taskforce. (2021). Natural products in drug discovery: Advances and opportunities. *Nature Reviews Drug Discovery*.
21. Bagalkotkar, G., Sagineedu, S. R., Saad, M. S., & Stanslas, J. (2006). Phytochemicals from *Phyllanthus niruri* Linn. and their pharmacological properties: A review. *Journal of Pharmacy and Pharmacology*.
22. Lachman, L., Lieberman, H.A., & Kanig, J.L. *The Theory and Practice of Industrial Pharmacy*. CBS Publishers, New Delhi.
23. Allen, L.V. *Pharmaceutical Dosage Forms and Drug Delivery Systems*. Lippincott Williams & Wilkins.
24. Ansel, H.C., Allen, L.V., & Popovich, N.G. *Pharmaceutical Calculations*. Lippincott Williams & Wilkins.
25. Harvey, A. L., Edrada-Ebel, R., & Quinn, R. J. (2015). The re-emergence of natural products for drug discovery in the genomics era. *Nature Reviews Drug Discovery*.