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## Formulation and Evaluation of Gokhuru Herbal Syrup

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### ABSTRACT

The goal of the current study is to formulate and evaluate a herbal syrup that contains *Gokhuru* (*Tribulus terrestris* Linn.), a medicinal plant that is frequently used in traditional Ayurvedic medicine to treat renal and urinary issues. Because gokhuru contains bioactive components such as steroidal saponins, flavonoids, alkaloids, glycosides, and tannins, it has important pharmacological properties like diuretic, anti-urolithiatic, nephroprotective, anti-inflammatory, and aphrodisiac actions. Gokhuru's dried fruits were gathered, verified, prepared, and extracted using an aqueous extraction technique. To formulate a tasty and stable herbal formulation, the extract was added to a syrup basis that had been made with the appropriate sweetening, flavoring, and preservative ingredients. Color, odor, taste, pH, viscosity, specific gravity, refractive index, and total soluble solids were among the organoleptic and physicochemical characteristics of the prepared syrup that were assessed. To guarantee the formulation's stability and safety, stability tests and microbial quality evaluation were also carried out. The prepared syrup had good stability during storage, satisfactory microbiological quality, and acceptable physicochemical properties, according to the results. The Gokhuru herbal syrup is a stable, safe, and patient-friendly dosage form with potential therapeutic benefits for renal and urinary tract problems, according to the study's findings. The formulation and standardization of herbal liquid formulations for better patient compliance and broader use in contemporary healthcare systems is supported by this work.

**Keyword:** Gokhuru, Herbal syrup, Herbal formulation, Ayurvedic Medicine, Liquid dosage form, Stability study, Physicochemical evaluation.

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## INTRODUCTION

Herbal medicines play a significant role in healthcare systems across the world due to their natural origin, therapeutic effectiveness, and relatively fewer side effects. With the growing awareness of the limitations and adverse effects associated with synthetic drugs, there is an increasing demand for herbal formulations that are safe, economical, and patient-friendly. Traditional systems of medicine such as Ayurveda, Unani, and Siddha have long utilized medicinal plants for the prevention and treatment of various diseases.<sup>[1]</sup> Among the various dosage forms, herbal syrups are widely used because they are easy to administer, palatable, and suitable for patients of all age groups, especially pediatric and geriatric populations. Syrups provide uniform distribution of active constituents, accurate dosing, and improved bioavailability. They also enhance patient compliance due to their pleasant taste and liquid nature.<sup>[2]</sup>

Gokhuru (*Tribulus terrestris* Linn.), belonging to the family Zygophyllaceae, is a well-known medicinal plant extensively used in traditional medicine. The fruits of Gokhuru contain important phytoconstituents such as steroidal saponins, flavonoids, alkaloids, glycosides, and tannins, which are responsible for its wide range of pharmacological activities. Traditionally, Gokhuru is used as a diuretic, aphrodisiac, anti-urolithiatic, anti-inflammatory, antioxidant, and renal protective agent. It is commonly prescribed for the treatment of urinary tract infections, kidney stones, dysuria, and reproductive disorders.<sup>[3]</sup>

Although Gokhuru possesses significant therapeutic potential, its effectiveness depends largely on the formulation and dosage form. Crude herbal preparations may suffer from issues such as poor stability, inconsistent dosing, and reduced patient acceptability. Therefore, the development of a standardised herbal syrup formulation of Gokhuru can help overcome these limitations by improving stability, palatability, and ease of administration.<sup>[4]</sup>

### **Herbal Medicines: Overview**

Herbal medicines are therapeutic preparations derived from plants or plant parts such as roots, leaves, stems, flowers, seeds, and fruits, which are used for the prevention, management, and treatment of various diseases. These medicines form the foundation of traditional healthcare systems including Ayurveda, Unani, Siddha, and Traditional Chinese Medicine, and have been practiced for thousands of years across different cultures.<sup>[5]</sup> In recent decades, herbal medicines have gained global recognition due to their natural origin, cost-effectiveness, cultural acceptance, and relatively fewer side effects when compared to synthetic drugs. According to the World Health Organization (WHO), a large proportion of the world's population relies on herbal

medicines for primary healthcare, particularly in developing countries where access to modern medicines may be limited.<sup>[6]</sup>

Despite their advantages, herbal medicines face challenges such as a lack of standardization, variability in quality, stability issues, and limited scientific validation. Factors like geographical location, harvesting conditions, processing methods, and storage can significantly affect the quality and efficacy of herbal products. Therefore, scientific formulation, evaluation, and quality control of herbal medicines are essential to ensure their safety, efficacy, and reproducibility.<sup>[7]</sup>

Modern pharmaceutical research focuses on the development of standardized herbal formulations using advanced extraction techniques, suitable dosage forms, and rigorous evaluation parameters.<sup>[8]</sup>

### **Importance of Herbal Syrups**

Herbal syrups are liquid oral dosage forms in which herbal extracts are dissolved or suspended in a sweetened aqueous vehicle.<sup>[9]</sup> They are one of the most commonly used herbal formulations due to their ease of administration, pleasant taste, and improved patient compliance. Herbal syrups are especially suitable for pediatric and geriatric patients who may have difficulty swallowing solid dosage forms like tablets and capsules.<sup>[10]</sup>

The liquid nature of syrups allows rapid absorption and better bioavailability of active constituents. Syrups also provide uniform distribution of medicinal ingredients, ensuring accurate and consistent dosing.<sup>[11]</sup> The addition of sweetening agents and flavoring substances helps in masking the bitter taste of herbal extracts, making the formulation more acceptable to patients. Moreover, herbal syrups are relatively easy to formulate, economical, and can be conveniently used for long-term therapy.<sup>[12]</sup>

### **Botanical Description of Gokhuru**

Gokhuru (*Tribulus terrestris* Linn.) is a small, prostrate, annual herb belonging to the family *Zygophyllaceae*. The plant is widely distributed in tropical and subtropical regions of India, Africa, Europe, and Australia. It commonly grows in dry, sandy soils and along roadsides and wastelands.<sup>[13]</sup>

The plant has spreading branches with opposite, pinnate leaves consisting of small oblong leaflets. The flowers are yellow in color, solitary, and axillary.<sup>[14]</sup> The fruit is a hard, spiny burr containing sharp pointed projections, which is a characteristic feature of the plant. The fruits are the most commonly used medicinal part and are rich in important phytoconstituents such as steroidal saponins, flavonoids, alkaloids, and glycosides.<sup>[15]</sup>

### **Traditional Uses of Gokhuru**

Gokhuru has been extensively used in traditional systems of medicine such as Ayurveda and Unani for centuries. It is traditionally known for its diuretic, aphrodisiac, and rejuvenating properties. In Ayurveda, Gokhuru is commonly used in the treatment of urinary tract disorders, including dysuria, urinary tract infections, and kidney stones.<sup>[16]</sup> The plant is also used as a renal tonic and is beneficial in maintaining urinary health. Additionally, Gokhuru is traditionally prescribed for sexual dysfunction, infertility, and general weakness<sup>[17]</sup> It is believed to enhance vitality, improve stamina, and support reproductive health. Other traditional uses include its application in inflammatory conditions, edema, and cardiovascular disorders.<sup>[18]</sup>

## PLANT PROFILE

**Table 1: Plant Profile of Gokhuru**

Parameter	Description
Botanical Name	<i>Tribulus terrestris</i> Linn.
Common Name	Gokhuru, Gokharu, Puncture Vine
Family	Zygophyllaceae
Kingdom	Plantae
Division	Magnoliophyta
Class	Magnoliopsida
Order	Zygophyllales
Genus	<i>Tribulus</i>
Species	<i>Tribulus terrestris</i>
Habit	Prostrate, spreading annual herb
Stem	Slender, branched, hairy, and prostrate
Leaves	Opposite, pinnately compound with small oblong leaflets
Flowers	Yellow, solitary, axillary, bisexual
Fruits	Hard, woody, spiny burrs with sharp projections
Seeds	Small, hard seeds enclosed within the fruit
Root	Long, slender, and fibrous root system

Geographical Distribution	Widely distributed in India, Pakistan, Sri Lanka, China, Africa, Australia, and Southern Europe
Habitat	Dry sandy soils, roadsides, open fields, wastelands, and riverbanks
Parts Used	Fruits, roots, and the whole plant
Major Phytoconstituents	Steroidal saponins, flavonoids, alkaloids, glycosides, tannins, fixed oils, and resins
Major Active Constituent	Protodioscin
Traditional Uses	Diuretic, aphrodisiac, anti-inflammatory, nephroprotective, and anti-urolithiatic agent
Therapeutic Uses	Urinary tract infections, kidney stones, dysuria, reproductive disorders, and general weakness
Ayurvedic Properties	Mutrala(diuretic), Ashmarihara(anti-urolithiatic), Balya(strengthening),Vrishya (aphrodisiac)
Dosage Form Used in Study	Herbal Syrup
Storage Conditions	Store in a cool, dry place away from direct sunlight



Figure 1



Figure 2

Figure 1 and 2: Physical appearance of the gokhuru seed

Table 2: Phytochemical Constituents of Gokhuru

Phytochemical Constituent	Examples	Pharmacological Activity
Steroidal Saponins	Protodioscin, Protogracillin	Aphrodisiac, diuretic
Flavonoids	Quercetin, Kaempferol	Antioxidant, anti-inflammatory
Alkaloids	Harmaline, Norharmaline	Neuroprotective activity
Glycosides	Saponin glycosides	Renal protective effect
Tannins	Condensed and hydrolysable tannins	Antimicrobial, antioxidant
Fixed Oils	Fatty acids	Nutritional and protective effects
Resins	Natural resin compounds	Anti-inflammatory activity

Table 3: Morphological Characteristics of Gokhuru

Plant Part	Characteristics
Root	Long, slender, fibrous
Stem	Prostrate, branched, hairy
Leaves	Opposite, pinnately compound, green
Flowers	Yellow, solitary, axillary
Fruits	Brown, spiny burrs with five nutlets
Seeds	Small, hard, enclosed within fruit

## MATERIALS AND METHOD

### METHODOLOGY (standard)

#### Collection and Authentication of Plant Material

Collect dried fruits of *Tribulus terrestris* L. (Gokhuru) from a reliable source. Authenticate the plant by a botanist and preserve a voucher specimen in the herbarium. Clean the fruits to remove dust and foreign matter.

#### Preparation of Plant Extract

**Powdering:** Dry the fruits under shade and grind into coarse powder. **Extraction:** Use aqueous extraction (for syrup formulation) or hydroalcoholic extraction if needed. **Procedure:** Soak 50–

100 g of powdered fruit in 500 mL of distilled water. Heat at 60–70°C for 1–2 hours with continuous stirring. Filter the extract through muslin cloth and then Whatman No. 1 filter paper. **Concentration:** Concentrate the filtrate using a water bath to get a thick extract suitable for syrup.

### Preparation of Syrup Base

Prepare simple syrup 66% w/v using the formula: 660 g sugar in 340 mL distilled water (heat gently until fully dissolved). Allow to cool before adding the extract.

### Procedure:

Mix the concentrated extract with syrup base. Add preservative and flavoring agent. the volume with distilled water. Stir continuously to get a homogeneous syrup. Fill in sterilized amber glass bottles and label properly.

**Table 4: Ingredient used in formulation of syrup**

S. No.	Ingredient	Category
1	Gokhuru Extract ( <i>Tribulus terrestris</i> )	Active ingredient
2	Sucrose	Sweetening agent / Syrup base
3	Sodium Benzoate	Preservative
4	Orange Flavor	Flavoring agent
5	Citric Acid	pH Adjusting Agent
6	Distilled Water	Vehicle

**Table 5: Formulation of Gokhuru Herbal Syrup (100 mL)**

S. No.	Ingredient	Quantity (for 100 mL)
1	Gokhuru Extract ( <i>Tribulus terrestris</i> )	10 g
2	Sucrose	66 g
3	Sodium Benzoate	0.1 g
4	Orange Flavor	0.2 mL
5	Citric Acid	0.1 g
6	Distilled Water	q.s. to 100 mL

### Method of preparation

Dissolve 66 g of sucrose in approximately 50 mL of distilled water with gentle heating. Add 10 g of concentrated Gokhuru extract and stir until uniformly dispersed. Add sodium benzoate and citric acid dissolved in a small quantity of water. Add flavoring agent and mix thoroughly. Make up the volume to 100 mL using distilled water. Stir continuously to obtain a homogeneous syrup. Filter if necessary and fill into sterilized amber-colored containers.

## EVALUATION OF HERBAL SYRUP

### pH measurement

Calibrate the pH meter using standard buffer solutions of pH 4.0 and 7.0. Take 20 mL of the prepared herbal syrup in a clean beaker. Immerse the electrode of the pH meter into the syrup.

Allow the reading to stabilize. Record the pH value at room temperature.

#### **Specific gravity:**

Clean and dry a specific gravity bottle (pycnometer). Weigh the empty bottle ( $W_1$ ). Fill the bottle with distilled water and weigh ( $W_2$ ). Empty and dry the bottle. Fill it with herbal syrup and weigh ( $W_3$ ). Calculate specific gravity using:

$$\text{Specific Gravity} = \frac{W_3 - W_1}{W_2 - W_1}$$

#### **Refractive index:**

Clean the prism surface of the Abbe refractometer. Place 1–2 drops of syrup on the prism. Close the prism assembly carefully. Adjust the instrument until a clear boundary line is visible. Record the refractive index at 25°C. Clean the prism after use.

#### **Viscosity:**

Transfer 100 mL of syrup into the sample container. Select an appropriate spindle of the Brookfield viscometer. Immerse the spindle completely in the syrup. Operate the viscometer at 25°C and 50 rpm. Allow the reading to stabilize. Record the viscosity in centipoise (cP).

#### **Alcohol content (if hydroalcoholic extract used)**

Take a measured quantity of syrup. Distill the sample using a distillation apparatus. Collect the distillate. Measure alcohol content using an alcoholmeter. Record the percentage of alcohol present in the syrup.

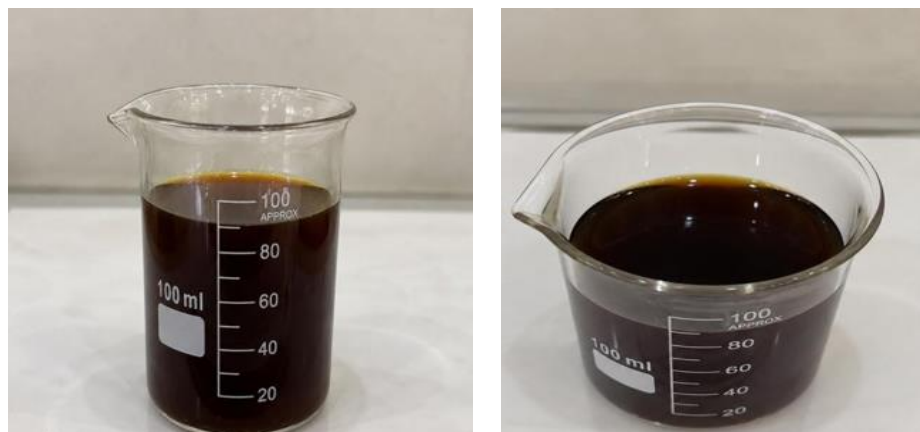
## RESULTS AND DISCUSSION

### **Organoleptic Evaluation**

The prepared Gokhuru syrup showed a brownish-yellow color with a clear and attractive appearance. The formulation was found to be clear and homogeneous, indicating good quality and stability. It possessed a characteristic herbal odor, confirming the presence of herbal constituents. The syrup had a sweet taste with a slight herbal aftertaste, making it palatable for consumption. No visible particles or phase separation were observed, demonstrating excellent clarity. Overall, the formulation exhibited excellent homogeneity and acceptable organoleptic properties suitable for oral use.

**Table 6: Organoleptic Evaluation of Gokhuru Herbal Syrup**

<b>Parameter</b>	<b>Observation</b>
Color	Brownish-yellow
Appearance	Clear and homogeneous
Odor	Characteristic herbal odor
Taste	Sweet with slight herbal aftertaste
Clarity	Clear
Homogeneity	Excellent



**Figure: 1, 2: Physical characteristics of formulated Gokhuru syrup**

### Physicochemical Evaluation

The physicochemical evaluation of the formulated Gokhuru syrup revealed satisfactory results. The pH of the syrup was found to be 5.6, indicating that the formulation is mildly acidic and suitable for oral administration. The specific gravity was determined to be 1.28, reflecting the appropriate concentration of dissolved solids and ensuring the desired consistency of the syrup. These results indicate that the formulation possesses acceptable physicochemical properties and good stability.

**Table 7: Physicochemical Evaluation of Gokhuru Herbal Syrup**

Parameter	Result
pH	5.6
Specific Gravity	1.28
Viscosity	1450
Refractive Index	1.445
Total Soluble Solids	64 °Brix

**Table 8: Physical Stability Evaluation**

Parameter	Observation
Sedimentation	Absent
Phase Separation	Absent
Crystal Formation	Absent
Color Change	No change
Odor Change	No change
Overall Stability	Stable

The formulated Gokhuru herbal syrup was successfully prepared and evaluated for its organoleptic, physicochemical, and microbiological characteristics. The syrup exhibited a clear brownish-yellow appearance with a characteristic herbal odor and pleasant sweet taste, indicating good patient acceptability. The pH value was found to be within the acceptable range for oral liquid formulations, suggesting stability and suitability for administration. The specific gravity and viscosity values confirmed the desired consistency and flow properties of the syrup. The

refractive index and total soluble solids (°Brix) values indicated proper concentration of dissolved solids and uniform formulation. Microbial analysis demonstrated that the total viable count was within acceptable limits and no pathogenic microorganisms were detected, confirming the microbiological safety of the preparation. Stability studies showed no significant changes in color, odor, pH, or viscosity during the storage period, indicating good stability of the formulation. Overall, the results suggest that the developed Gokhuru herbal syrup is a stable, safe, and effective herbal dosage form with acceptable quality characteristics suitable for therapeutic use.

## CONCLUSION

The prepared syrup exhibited satisfactory organoleptic characteristics, including acceptable color, odor, taste, and appearance. Physicochemical evaluation revealed that the pH, viscosity, specific gravity, refractive index, and total soluble solids were within acceptable limits, indicating the quality and stability of the formulation. Microbial studies confirmed the absence of pathogenic microorganisms and demonstrated that the microbial load was within permissible limits, ensuring the safety of the syrup. Furthermore, stability studies showed no significant changes in the evaluated parameters during the storage period, indicating good stability of the formulation. Based on the obtained results, it can be concluded that the formulated Gokhuru herbal syrup is a stable, safe, and patient-friendly herbal dosage form with potential therapeutic benefits for urinary and renal disorders. The study also supports the development and standardization of herbal liquid formulations for improved patient compliance and wider application in modern healthcare systems.

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