Physicochemical, Phytochemical, and Stability Evaluation of a Polyherbal Syrup Formulated from *Moringa oleifera*, *Phyllanthus emblica*, and *Curcumin longa*

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ABSTRACT

Background: Herbal medicines are widely used due to their safety, accessibility, and minimal side effects compared to synthetic drugs. *Moringa olefera*, *Phyllanthus emblica*, and *Curcuma longa* are medicinal plants rich in bioactive compounds, including flavonoids, phenolic compounds, tannins, and antioxidants. Combining these herbs in a single formulation may produce synergistic therapeutic benefits suitable for use in respiratory and immune-related conditions. To formulate a polyherbal syrup using aqueous extracts of *M. oleifera*, *P. emblica*, and *C. longa*, and to evaluate its physiochemical properties, phytochemical composition, antioxidant activity, and stability under different temperature conditions.

Methods: Dried leaves of *M. oleifera* and *P. emblica*, and *C. longa* were powdered and macerated in distilled water to obtain decoctions. Three formulations (S1, S2, and S3) were prepared using varying ratios of the decoctions and a fixed quantity of Chiuri honey as a natural preservative and thickening agent. Physicochemical parameters, including pH, specific gravity (pycnometer method), and viscosity (Ostwald viscometer), were measured. Qualitative phytochemical screening and DPPH antioxidant spot tests were conducted. Stability testing was carried out for seven days at cold (6 °C), hot (50 °C), and room-temperature conditions.

Results: All extracts showed positive results for alkaloids, flavonoids, phenols, tannins, and antioxidant activity. The pH of formulations ranged from slightly alkaline (S1: 7.9) to mildly acidic (S2: 6.6; S3: 6.5). Specific gravity values were 1.18-1.19, and viscosity ranged between 2.32-2.71 Poise. Formulations remained stable under cold and room temperatures, while high-temperature exposure led to evaporation and reduced volume.

Conclusion: The polyherbal syrup demonstrated desirable physicochemical characteristics, strong phytochemical presence, antioxidant potential, and good stability, indicating its suitability as a natural therapeutic preparation. Further quantitative phytochemical evaluation, antimicrobial assessment, and advanced instrumental analysis are recommended to validate and enhance its medicinal potential.

Keywords*: Anti-oxidant, physicochemical, phytoconstituent, polyherbal, syrup*

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INTRODUCTION

For thousands of years, nature has been a source of therapeutic agents. A remarkable number of contemporary medications have been derived from natural sources, especially plants, and many of these have been used in traditional medicine. In order to produce efficient chemotherapeutic and other bioactive medicines, novel natural products needed will be optimized based on their biological activities employing medicinal chemistry and combinatorial chemical and biosynthetic technologies (Rajmane et al., 2020). Herbal syrup is made by combining concentrated plant decoction with either sugar or honey, along with alcohol. The procedure of decoction is used to create the herbal syrup. Thickening and preserving the formulation can be achieved by combining an herb decoction with sugar. This was responsible for increasing the shelf life of the formulation (Mali et al, 2019). Cough syrup and other illnesses are treated with herbal plants and formulations **(Devkar et al., 2021).** The herbal syrups are flavored syrups made primarily for taste enhancement using natural or herbal flavors, medicated syrups contain herbal extracts used for therapeutic or medicinal purposes, and artificial syrups include synthetic ingredients or flavorings alongside herbal components (Khandave et al., 2025).

Advantages of Herbal Syrup: **(**Khandave et al., 2025**)**

- Generally free from side effects
- Safe and non-toxic
- Easily accessible and available
- Dosage can be conveniently adjusted based on a child's body weight
- Does not require assistance for administration; patients can take it independently

- Medicinal herbs can be cultivated in common, local areas
- High patient compliance, especially in children, due to its sweet taste
- Functions as a natural preservative by inhibiting the growth of bacteria, fungi, and mold through high osmotic pressure.

Moringa oleifera Lam. (Family: Moringaceae) is widely planted for its nutritional and medicinal properties (Kumar et al., 2025). Phyllanthus emblica L. has been widely used in Ayurveda, both for its medicinal properties and as an edible (tonic) herb (Gaire & Subedi, 2014). *Curcuma longa* Linn, often known as turmeric, is a member of the Zingiberaceae family. The plant has numerous potential therapeutic uses. Anti-inflammatory, biliary, hepatoprotective, blood purifier, antioxidant, detoxifying and rebuilding liver tissue, anti-asthmatic, anti-cancer, and digestive are the advantageous properties (Nerkar & Nagarkar, 2023).

Literature Review

Herbal extracts provide a holistic approach to health by combining traditional knowledge with modern clinical advances in health care modalities. A large percentage of humans globally, roughly 70 % include natural medicines in their predominant medical regimens, underscoring the pervasiveness of this use of herbal therapies (Sameen & Sultan, 2025). Their varied pharmacological activities and lengthy history in traditional medical systems like Ayurveda and Traditional Chinese Medicine (TCM) make *Moringa oleifera, Emblica officinalis* (Amala), *Curcuma longa* (Turmeric), and honey especially noteworthy.

- **Extract from *Moringa oleifera* Profile of Botany and Phytochemistry:**

Moringa olefera Lam. belongs to the family Moringaceae. The plant is widely cultivated in tropical and subtropical regions for nutritional, medicinal, and agricultural purposes. The plant is valued for its fast growth, drought tolerance, and high biomass production, making it a key species in agroforestry and nutrition programs **(**Devkota & Bhusal, 2020).

Phytochemical profile: *Moringa oleifera* is one of the phytochemically rich medicinal plants. Its leaves, seeds, pods, and bark contain numerous bioactive compounds responsible for its medicinal uses. Major phytochemical constituents: Flavonoids-Quercetin, Kaempferol, Isorhamnetin, and Phenolic Acids-Gallic acid, Chlorogenic acid, caffeic acids, etc. Isothiocyanates-4-(α-L-rhamnopyranosyloxy) benzyle isothiocyanate (a major antimicrobial and anticancer-active compound), etc. **(**Pareek et al., 2023).

- **Extract from *Phyllanthus emblica* L. Profile of Botany and Phytochemistry:**

Phyllanthus emblica L. (syn. *Emblica officinalis*), commonly known as amla, belongs to the family Phyllanthaceae. It is one of the most important plants in Ayurveda and traditional medicine (Baliga et al., 2013).

Phytochemical Profile: *Phyllanthus emblica* is highly valued for its diverse phytochemicals, particularly antioxidants. Major phytochemicals are- Tannins-Emblicanin A and B, punigluconin; Phenolic compounds-Gallic acid, ellagic acid; Flavonoids-Quercetin, Kaempferol, etc. (Gaire & Subedi, 2014).

- **Extract from *Curcuma longa* Profile of Botany and Phytochemistry:**

Curcuma longa L. (Family Zingiberaceae), commonly known as turmeric, is a perennial, rhizomatous herb native to South and Southeast Asia. It is widely cultivated for its rhizomes, which are used as a spice, food coloring, and traditional medicine. *Curcuma longa* is a key crop in traditional medicine (Ayurveda, TCM), culinary applications, and industrial use as a natural colorant (Aggarwal & Sung, 2009).

Phytochemical Profile: *Curcuma longa* is rich in bioactive compounds, primarily concentrated in the rhizome. Major phytochemical constituents are: Curcuminoids-curcumin, Demethoxycurcumin; Volatile oils-Turmerone, atlantone; Phenolic compounds-Ferulic acid, vanillic acid, etc. **(**Prasad et al., 2014).

Honey has long been recognized for its natural antimicrobial properties, attributed to its low pH, high sugar content, and the presence of hydrogen peroxide and bioactive compounds such as flavonoids **(**Ogwu & Izah, 2025).

The objective of this study was the formulation of different compositions of polyherbal syrup with selected plant parts aqueous extracts, and to evaluate their physicochemical properties and compare the formulations.

METHOD AND MATERIALS

The project work was conducted in the laboratory of Butwal Multiple Campus, Rupandehi, Lumbini Province, Nepal. Owing to the country's rich plant diversity, the region provides excellent scope for investigating the synergistic effects of polyherbal formulations. Plant samples required for the study were collected from local markets in Butwal Sub-Metropolitan City (Rupandehi) and Gulmi District. The collected specimens were taxonomically identified and authenticated by Dr. Babu Ram Nepali, Department of Botany, Butwal Multiple Campus, Nepal.

Table 1: Collection of Plant Materials

Common Name	Scientific Name	Plant Parts Used
Drumstick tree	*Moringa oleifera*	Leaves
Indian Gooseberry	*Phyllanthus emblica*	Leaves
Turmeric	*Curcuma longa*	Roots

A B C

Figure 1: Collection of Plant Parts A: *Moringa oleifera* B: *Phyllanthus emblica* C: *Curcuma longa*

Chemicals and Standards

The chemicals used in this study included methanol (Chem Synth Fine Chemicals), ferric chloride (Loba Chem Pvt. Ltd.), and DPPH (HiMedia Laboratories Pvt. Ltd.). All other reagents were of the highest commercially available analytical grade. The instruments employed were a hot air oven (Scientific Instrument Pvt. Ltd.), a digital weighing machine (GT-210), a pH meter, Ostwald's viscometer, and a laboratory refrigerator.

Preparation method for Polyherbal Syrup by the method of Khandave et al. (2025), with some modifications

- *Preparation of drug powder:* The required amount of each dried leaf (*Moringa, Pyllanthus, Curcuma*), about 20-40 g, was taken and crushed into fine powder using a grinder, mortar, and pestle. Each drug was powdered separately, and then each drug was collected in a separate vessel and weighed. Each drug should fulfill

the required amount. Curcumin powder should be weighed at 5 g, Moringa 10 g, and amla leaves 10 g.

- *Extraction process:* each powdered drug was subjected to the process of maceration; each drug was soaked separately in a different beaker containing 200 mL of distilled water. 5 g *Curcuma longa* is put in 200 mL distilled water, and both the *Phyllanthus* and *Moringa* are 10 g in 200 mL distilled water, and stirred for some time.
- *Formulation of Polyherbal Syrups*

Ingredients	S1	S2	S3
Curuma longa	4 mL	7 mL	7 mL
Phyllanthus emblica	7 mL	4 mL	7 mL
Moringa oliefera	7 mL	7 mL	4 mL
Chiuri Honey	18 g	18 g	18 g

Note: The density of honey is 1.4 g/mL.

Volume = Mass/Density=18/1.4=12.9, i.e., ~13 mL.

- *Final Herbal Syrup Preparation:* The herbal decoctions were mixed with Chiuri honey in appropriate proportions, maintaining honey at 60-70% (v/v) of the total formulation. The ratios of the three decoctions were varied according to the formulation design, while the amount of honey remained constant. The mixture was stirred gently until a uniform and homogeneous polyherbal syrup was obtained.

Evaluation Test for the Polyherbal Syrups

Physicochemical Parameters of Syrup

Colour:

Odour:

Test Examination

- **pH Measurement:** The pH of different formulations in 1% w/v and 10% w/v of water-soluble portion was determined using a pH meter using a standard pH electrode under room temperature (Yadav et al., 2025).

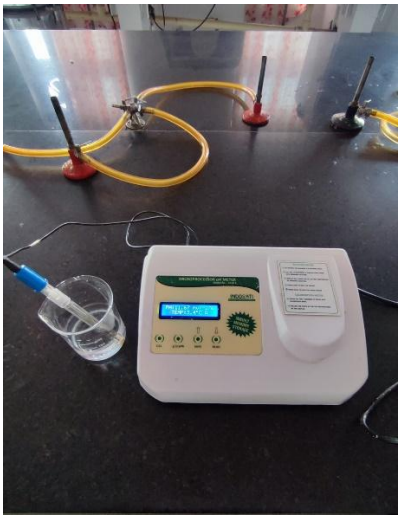

Figure 2: pH Measurement

- **Specific Gravity Test**: Specific gravity of the polyherbal syrup was determined using a pycnometer, as pycnometers are specially designed for measuring the density of viscous substances and provide precise measurements in a laboratory setting (Cole-Parmer). The empty pycnometer was first weighed, then filled with distilled water and weighed again. Afterward, the pycnometer was filled with the polyherbal syrup and weighed.
  The specific gravity of the syrup was calculated using the following formula;

$$\text{Specific Gravity} = \frac{\text{Density of Substance}}{\text{Density of Reference}}$$

Figure 3: Specific Gravity Bottle

- **Viscosity Measurement**: Mali et al. (2019) thoroughly clean the Ostwald viscometer with warm chromic acid and dry it. The following steps are involved;

i) Placed the dry viscometer in a vertical position on a suitable stand.
ii) Fill the examination sample (syrup) up to the mark.
iii) Count the time required to flow from the upper mark to the lower. Repeat step three times and record the time flow.
iv) Similarly, wash the viscometer, rinse with water, fill up to the marks, and record the time flow.

Then, determine the density of the liquid used and using the relation, viscosity can be calculated as;

$$\eta_{syrup} = \eta_{water} \times \frac{\rho_{syrup}}{\rho_{water}} \times \frac{t_{syrup}}{t_{water}}$$

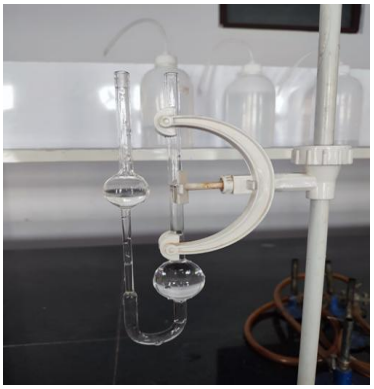

Figure 4: Ostwald's viscometer

- **Qualitative phytochemical Screening:** Medicinal plants possess diverse pharmacological properties, including antineoplastic, antimicrobial, antioxidant, anti-inflammatory, analgesic, antidiabetic, antihypertensive, and antidiarrheal effects. Their therapeutic potential is largely determined by phytoconstituents such as alkaloids, flavonoids, phenolics, tannins, etc. (Bhandari et al., 2025).

- **Qualitative Analysis of Antioxidant Activity:** Antioxidants can scavenge free radicals or reduce oxidizing agents. Common qualitative assays are based on colorimetric reactions, where a color change indicates antioxidant activity (Siddhuraju & Becker, 2003). The DPPH (2,2-diphenyl-1,1-picrylhydrazyl) free

radical scavenging assay, also known as the qualitative spot test, can be performed as described by Blois (1958).

i) Prepare a 0.1 mM DPPH solution in methanol.

ii) Place a few drops of the plant extract or syrup on a white tile or microplate well.

iii) Add 1-2 drops of DPPH solution to the extract.

iv) Observe the colour change; Purple colour turns to Yellow or colorless, indicating the presence of antioxidant compounds.

RESULTS AND DISCUSSION

Qualitative Phytochemical Analysis of Decoctions

Table 2: The Preliminary Qualitative Analysis of Phytoconstituents of Collected Plant Sample Extract

Phytoconstituents	***Moringa oliefera***	***Phyllanthus emblica***	***Curcuma longa***
Alkaloid	+	+	+
Flavonoid	+	+	±
Phenols	+	+	+
Tannin	+	+	+
Antioxidant	+	+	+

+ = Strongly Presence ± = Moderately Presence - = Absence

Figure 5: Phytochemical Screening of plant extracts and antioxidant test

Physicochemical parameters

For the formulated polyherbal syrups S1, S2, and S3

- Color = Brownish black
- Odour = Honey smell
- Taste Honey sweet immediately but a bitter-like taste in the throat afterward

S.N	Parameters	S1	S2	S3
1.	pH	7.9 (Slightly alkaline)	6.6 (Acidic)	6.5 (Acidic)
2.	Specific Gravity	1.19	1.18	1.18
3.	Viscosity	2.32 Poise	2.61 Poise	2.71 Poise
4.	**Organoleptic Properties**			
	• Color	Yellowish		
	• Odour	Honey smell		
	• Taste	Honey is sweet immediately, but bitter taste in the throat afterward		

- **pH**: The pH of the S1 is 7.9 (slightly basic), S2 is 6.6, and S3 is 6.5 (acidic), respectively.
- **Specific Gravity Test:** The specific gravity of the polyherbal syrup was 1.19, 1.18, and 1.18 for S1, S2, and S3, respectively.
- **Viscosity:** The viscosities of the polyherbal syrup samples were 2.32, 2.61, and 2.71 poise for S1, S2, and S3, respectively.
- **Stability Testing:** Samples S1, S2, and S3 were placed in separate test tubes, wrapped with aluminium foil, and positioned in small beakers to ensure proper placement. The samples were then exposed to three different temperature conditions for observation.

The samples were stored under three different temperature conditions for a 7-day observation period:

i) **Cold temperature (6 °C**): Test tubes containing S1, S2, and S3, each placed in a beaker, were stored in a refrigerator and observed daily.

ii) **Hot temperature (50 °C**): Test tubes containing S1, S2, and S3, each in a beaker, were placed in a hot oven and observed daily

iii) **Normal temperature (25-39 °C):** Test tubes containing S1, S2, and S3, each in a beaker, were kept at ambient conditions in a safe location and observed daily.

Figure 6: Stability Measurement of polyherbal syrup

DISCUSSION

Herbal products are increasingly regarded as safe alternatives to synthetic drugs, which are often associated with adverse effects on human health and the environment. Traditionally, herbs have been valued for their medicinal, flavoring, and aromatic properties. Promoting their use globally is timely and important.

The formulated polyherbal syrup, containing M. oleifera, P. emblica, and Curcumin, exhibited desirable physicochemical characteristics, indicating a stable and effective preparation. The syrup was visually clear with a yellow color, had a characteristic herbal odor, and a honey-like taste, reflecting its natural components.

- The polyherbal syrup contained major phytoconstituents, including alkaloids, flavonoids, phenols, tannins, and antioxidants, consistent with previous reports for formulations containing M. oleifera, C. longa, P. emblica, and honey (Siddhuraju & Becker, 2003; Shukla et al., 2023; Pareek et al., 2023).

- In our study, the pH of the formulations was slightly alkaline for S1, whereas S2 and S3 were mildly acidic. In contrast, Rajmane et al. (2020) reported neutral pH for a polyherbal syrup, making the pH of S2 comparable to their findings.
- The specific gravity of the formulations ranged from 1.18 to 1.19, indicating that the syrup's density is within the acceptable range for consistency and accurate dosing (WikiDoc, n.d.).
- The viscosity of the syrup ranged from 2.32 to 2.71 Poise, which is consistent with previously reported herbal syrups typically exhibiting viscosities of 2-3 Poise (Mohan et al., 2021; Pratikeswar & Sahu, 2023), indicating that the prepared formulation falls within acceptable limits for both traditional and modern herbal syrups.
- Stability testing indicated that the syrup maintained its integrity at 4 °C, room temperature, and 50 °C for up to 72 hours, with no significant changes in appearance, pH, turbidity, or homogeneity.

CONCLUSION

This study successfully evaluated the physicochemical and antioxidant properties of polyherbal syrup collected from diverse sources in Nepal, including herbal and floral types. Key parameters analyzed include pH, specific gravity, viscosity, qualitative phytochemical screening, stability testing upon time lapse of 7 days, and daily evaluation. The effectiveness of this polyherbal syrup, a daily dose of one to two teaspoons, for patients with sore throat, hoarseness of voice, and conditions like chronic bronchitis, asthmatic bronchitis, and acute upper respiratory tract infection in patients of all ages.

NOVELTY ASPECT OF PROJECT WORK

The development of a polyherbal syrup leverages Nepal's biodiversity and traditional medical knowledge, enhancing therapeutic efficacy through synergistic plant combinations. This approach supports holistic healthcare, promotes sustainable herb cultivation, boosts local economies, and strengthens Nepal's role in the growing herbal medicine industry.

RECOMMENDATION

The recommendations for further work are as follows;

- Conduct antibacterial testing and Fourier Transform Infrared (FTIR) spectroscopy to assess the quality and efficacy of the polyherbal syrup.

- Use High Performance Liquid Chromatography (HPLC) for separation and quantification of non-volatile and thermally unstable bioactive compounds, such as phenolics, flavonoids, vitamins, and sugars.
- Perform quantitative phytochemical analysis to determine the extract levels of bioactive compounds.
- Investigate market dynamics and consumer preferences to guide further research and inform policymaking for polyherbal syrups.

DATA AVAILABILITY STATEMENT: The data that support the findings of this study are available from the corresponding author upon reasonable request.

AUTHOR CONTRIBUTIONS: Arjun B. and Guru P. P. designed the study. Guru P. P. and Puskar P. wrote the manuscript. Arjun B., Guru P.P. conducted experiments and data analysis. All authors reviewed and approved the final draft.

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