

Formulation and Evaluation of a Polyherbal Refreshing Drink with Antioxidant Potential

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ABSTRACT

The consumption of carbonated soft drinks containing high levels of sugar, artificial additives, and preservatives has been associated with various health problems including obesity, metabolic syndrome, and dental disorders. Herbal refreshing drinks represent a promising alternative as functional beverages that provide hydration along with therapeutic benefits derived from medicinal plants. The present study aimed to formulate and evaluate a polyherbal refreshing drink using selected medicinal herbs such as *Mentha piperita*, *Ocimum sanctum*, *Zingiber officinale*, *Emblca officinalis*, *Citrus limon*, *Vaccinium myrtillus*, and *Citrus reticulata*. Three formulations (F1, F2, and F3) were prepared by varying the concentrations of herbal extracts and sweetening agents. The formulations were evaluated for organoleptic characteristics, physicochemical parameters, phytochemical constituents, antioxidant activity using DPPH assay, and microbiological safety. The results revealed that all formulations exhibited acceptable sensory and physicochemical properties with pH ranging from 4.2 to 4.8 and total soluble solids between 8–12 °Brix. Phytochemical screening confirmed the presence of flavonoids, tannins, phenolic compounds, terpenoids, and alkaloids. Antioxidant evaluation demonstrated significant radical scavenging activity, with F3 showing the highest inhibition (82%), followed by F2 (74%). Microbiological analysis confirmed that all formulations were within permissible microbial limits. Among the tested formulations, F2 demonstrated the best balance between antioxidant potential and sensory acceptability. The developed polyherbal refreshing drink can serve as a natural functional beverage and a healthier alternative to synthetic soft drinks.

INTRODUCTION

In recent decades, rapid urbanization, sedentary lifestyles, and changing dietary habits have significantly influenced global beverage consumption patterns. Carbonated soft drinks and artificially flavored beverages have become widely consumed, particularly among younger populations. However, excessive intake of sugar-sweetened beverages has been associated with several health complications including obesity, insulin resistance, metabolic syndrome, and type 2 diabetes [1,2].

Growing awareness regarding these health risks has encouraged consumers to seek natural and healthier beverage alternatives. Herbal refreshing drinks have emerged as a promising category of functional beverages prepared using medicinal plant extracts rich in bioactive phytochemicals such as flavonoids, phenolic compounds, tannins, alkaloids, and essential oils [3,4]. These beverages not only provide hydration but also deliver health benefits including antioxidant protection, digestive stimulation, and immune support. Functional beverages represent one of the fastest-growing sectors in the nutraceutical and food industries. These beverages are designed to deliver physiological benefits beyond basic nutrition, such as improved immunity, enhanced digestion, and reduced oxidative stress [5]. Plant-based beverages rich in natural antioxidants play an important role in neutralizing reactive oxygen species (ROS) and preventing

oxidative damage associated with chronic diseases such as cardiovascular disorders, diabetes, and neurodegenerative conditions [6]. Traditional systems of medicine such as Ayurveda have long utilized herbal drinks and decoctions for maintaining health and preventing disease. Herbal preparations including tulsi tea, ginger decoctions, and mint infusions have been traditionally consumed to improve digestion, relieve fatigue, and boost immunity [7]. Modern scientific investigations have validated many of these traditional claims by identifying the phytochemical constituents responsible for therapeutic activity. Medicinal plants such as *Mentha piperita*, *Ocimum sanctum*, *Zingiber officinale*, and *Emblca officinalis* contain bioactive compounds with strong antioxidant and anti-inflammatory properties. For example, tulsi contains eugenol and rosmarinic acid, ginger contains gingerols and shogaols, and amla is rich in vitamin C and polyphenols [8]. These compounds contribute to the functional and therapeutic value of herbal beverages. Despite the traditional use of herbal drinks, scientific standardization of formulations is necessary to ensure consistency, stability, microbial safety, and consumer acceptability. Evaluation parameters such as pH, total soluble solids, viscosity, antioxidant activity, and microbial load are essential for assessing the quality and safety of functional beverages [9]. Therefore, the present study was undertaken to formulate and evaluate a polyherbal refreshing drink using

selected medicinal plants and to assess its physicochemical properties, phytochemical composition, antioxidant activity, and microbiological safety to establish its potential as a functional beverage.

METHODOLOGY

Collection and Authentication of Herbal Drugs

Medicinal plants including mint (*Mentha piperita*), tulsi (*Ocimum sanctum*), ginger (*Zingiber officinale*), amla (*Embllica officinalis*), lemon (*Citrus limon*), blueberry (*Vaccinium myrtillus*), and tangerine (*Citrus reticulata*) were selected based on their antioxidant and medicinal properties. The herbal materials were authenticated by a qualified botanist at S.V. University, Tirupati.

Preparation of Herbal Refreshing Drink

Herbal extracts were prepared using infusion and decoction methods depending on plant material characteristics. Mint and tulsi leaves were extracted by infusion in hot water (80–90°C), while ginger and amla were extracted using decoction by boiling in water. The extracts were filtered and combined with lemon juice, honey, sugar, salt, and flavoring agents. The final mixture was diluted with distilled water to obtain a total volume of 1000 mL and stored in sterilized containers under refrigeration.

Three formulations (F1, F2, F3) were prepared with varying concentrations of herbal ingredients to optimize taste and antioxidant potential.

Organoleptic Evaluation

The prepared formulations were evaluated for sensory attributes including color, taste, aroma, appearance, and overall acceptability using a panel evaluation method.

Physicochemical Evaluation

The following parameters were determined:

- pH measurement using a digital pH meter
- Total soluble solids (°Brix) using refractometer
- Viscosity using viscometer
- Titratable acidity

These parameters are essential indicators of beverage quality and stability.

Phytochemical Screening

Qualitative phytochemical tests were performed to detect flavonoids, tannins, phenolic compounds, alkaloids, and terpenoids using standard procedures.

Antioxidant Activity

Antioxidant activity was determined using the DPPH radical scavenging assay. The decrease in absorbance at 517 nm indicated radical scavenging activity.

Microbiological Evaluation

Microbial safety was assessed by determining total plate count and coliform count using nutrient agar and selective media.

RESULTS AND DISCUSSION



Fig.1: Organoleptic Evaluation

Table 1: Organoleptic Evaluation of Formulations

Parameter	F1	F2	F3
Color	Light reddish	Reddish brown	Dark brown
Odor	Mild herbal	Pleasant herbal	Strong pungent
Taste	Sweet & mild	Balanced sweet-herbal	Slightly bitter
Appearance	Clear	Clear	Slight turbidity
Overall Acceptability (Score /10)	7.5	9.0	6.5

Table 2: Physicochemical Parameters

Parameter	F1	F2	F3	Acceptable Range
pH	4.8	4.5	4.2	3.5–5.5
Total Soluble Solids (°Brix)	12°	10°	8°	8–15°
Viscosity (cP)	1.2	1.4	1.6	1–2 cP
Acidity (%)	0.25	0.30	0.38	0.2–0.5

Table 3: Preliminary Phytochemical Tests

Phytoconstituent	F1	F2	F3
Flavonoids	+	++	+++
Tannins	+	++	+++
Phenolic compounds	++	+++	+++
Terpenoids	+	++	+++
Alkaloids	Trace	+	+

Table 4: DPPH Radical Scavenging Activity

Formulation	% Inhibition
F1	62%
F2	74%
F3	82%
Ascorbic Acid (Standard)	90%

Table 5: Microbiological Evaluation

Test	F1	F2	F3	Acceptable Limit
Total Plate Count (CFU/mL)	35	30	28	<100
Coliform Count	Absent	Absent	Absent	Absent

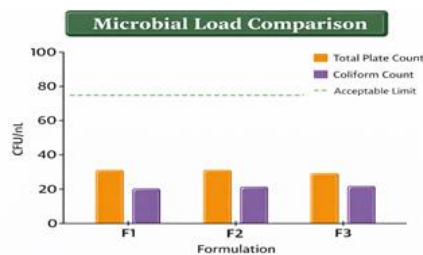


Fig.2: Microbial load comparison

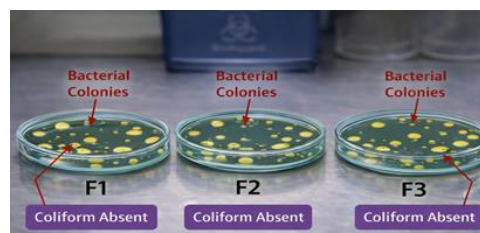


Fig.3: Microbial growth present/absent

Table 6: Comparison with Market Soft Drinks

Parameter	Herbal Drink (F2)	Synthetic Soft Drink
Sugar Content	Moderate	High
Artificial Additives	Absent	Present
Antioxidant Activity	High	Low
Health Benefits	Yes	Minimal
Caffeine	Absent	Often Present

Organoleptic Evaluation

Among the three formulations, F2 showed the highest overall acceptability due to its balanced herbal flavor and pleasant aroma.

Physicochemical Properties

The pH of the formulations ranged between **4.2 and 4.8**, indicating a mildly acidic environment favorable for beverage stability. Total soluble solids ranged between **8–12 °Brix**, suggesting acceptable sweetness levels.

Phytochemical Analysis

Phytochemical screening confirmed the presence of flavonoids, phenolic compounds, tannins, and terpenoids in all formulations, indicating potential antioxidant activity.

Antioxidant Activity

DPPH assay results showed significant antioxidant potential:

- F1: 62% inhibition
- F2: 74% inhibition
- F3: 82% inhibition

The increased herbal concentration in F3 contributed to higher radical scavenging activity.

Microbiological Evaluation

All formulations showed microbial counts below permissible limits, confirming microbiological safety.

Comparative Evaluation

Compared to synthetic soft drinks, the herbal beverage demonstrated lower sugar content, absence of artificial additives, and higher antioxidant activity.

Overall, formulation F2 provided the best balance between sensory acceptability and antioxidant potential.

CONCLUSION

The present study successfully formulated and evaluated a polyherbal refreshing drink using medicinal plants known for their antioxidant and health-promoting properties. The prepared formulations satisfactory organoleptic characteristics, acceptable physicochemical parameters, and significant antioxidant activity. Phytochemical screening confirmed the presence of bioactive compounds responsible for the therapeutic potential of the beverage. Antioxidant studies revealed strong radical scavenging activity, while microbiological evaluation confirmed the safety of the formulations. Among the tested formulations, F2 was identified as the optimized formulation due to its balanced sensory properties, adequate antioxidant activity, and acceptable physicochemical characteristics. The developed herbal refreshing drink can serve as a natural functional beverage and a healthier alternative to synthetic soft drinks. Further studies involving shelf-life determination, large-scale production, and clinical evaluation are recommended to establish its commercial viability.

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CONFLICT OF INTERESTS

The authors declare no conflict of interest

ETHICS APPROVAL

Not applicable

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AI TOOL DECLARATION

The authors declare that no AI and related tools are used to write the scientific content of this manuscript.

DATA AVAILABILITY

Data will be available on request

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