

# Development and Assessment of a Nutraceutical Herbal Soft Drink

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## Abstract

*The objective of this research was to develop and assess a nutraceutical herbal soft drink as a healthier alternative to conventional soft drinks, which have been scrutinized for their potential health risks due to high consumption rates. With an increasing number of individuals looking for healthier drink options, this study introduced a soft drink crafted from traditional herbs known for their nutritional benefits. The primary ingredients chosen for this soft drink were Ashwagandha, Bael fruit, Ginger, Turmeric, Amla, Mentha, and Black peppers, selected for their longstanding use in traditional home remedies due to their refreshing and revitalizing properties. The soft drink underwent physico-chemical evaluation and demonstrated optimal levels of titratable acidity, total soluble solids were 18% and a pH value of 5.3, aligning with the standards for commercial beverages. Additionally, the drink's impact on human nails and teeth was assessed. This newly developed nutraceutical herbal drink offers an affordable and tasty alternative that could contribute positively to consumer health. No bacterial colonies were present in the developed herbal soft drink, indicating the levels were within established standards. A nine-point hedonic scale sensory analysis of the beverage revealed strong consumer preference for its color, taste, flavor, and texture attributes. Analysis of the formulation showed flavonoid content of 75 mg/100 ml, phenolic content of 86 mg/100ml, and vitamin C content of 250 mg/100 ml. Antioxidant analysis demonstrated the formulation had a 72.55% potential. The developed nutraceutical beverage provides customers with an affordable and practical option, with very good taste qualities and possible health benefits. This drink can replace synthetic beverages available in the retail market.*

**Keywords:** Herbal soft drink, nutraceuticals, antioxidant, immunomodulator, innovative nutraceutical beverage development

## INTRODUCTION

Nutraceutical is a combined term obtained from nutrition and pharmaceuticals. It is believed the

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term was first introduced by DeFlice and the Foundation for Innovation in Medicine circa 1989. Further clarification was provided in a 1994 press release, defining nutraceuticals as substances found in or derived from foods that offer health benefits, including disease prevention and treatment. These can include isolated nutrients, dietary supplements, specialized diets, genetically modified foods, herbal products, and even processed items like cereals, soups, and beverages [1]. Nutraceuticals are increasingly recognized as effective approaches for addressing or managing various lifestyle-related conditions, such as diabetes, obesity, cancer, arthritis, and hypertension [2].

Nutraceuticals are gaining prominence in India's expanding health market and globally. They offer

complementary health benefits and are becoming increasingly significant in 21st-century therapeutic approaches [3]. Beverages serve as an ideal medium for incorporating nutraceutical ingredients for enrichment, such as soluble fiber or herbal extracts [4]. While many nutraceutical beverages are derived from fruits and vegetables, others come from plants like tea, coffee, cocoa, soybeans, and even animal products like milk and dairy-based drinks, as well as alcoholic beverages. Numerous traditional herbs with nutraceutical properties are commonly consumed in the summer for refreshment and nutrition [5]. Incorporating these herbs into soft drinks capitalizes on their perceived health benefits. India's rich botanical diversity presents abundant opportunities for innovative nutraceutical beverage development [6].

With a growing demand for innovation in the soft drink sector and the recognition of readily available herbs for their nutraceutical properties, this research aims to create a nutraceutical soft drink using these herbs. The goal is to develop a beverage that not only offers a refreshing taste and cooling effect but also provides various health benefits.

### **Background**

Modern soft drinks encompass a wide variety of products, which can be categorized based on several factors including sugar content, fruit juice content, flavor, carbonation level, primary non-water ingredients, and intended functionality [7].

In addition to plain drinking water, some of the most consumed soft drink varieties include:

- Ready-to-drink beverages flavored with natural or artificial essence. These are prepared for immediate consumption without further preparation.
- Ready-to-drink beverages containing whole fruits or fruit juice. As with essence-flavored drinks, these require no dilution or mixing prior to drinking.
- Beverages designed for dilution prior to consumption. These concentrates must be mixed with water or another liquid before enjoying.

Functional beverages constitute an increasingly significant portion of the overall drink marketplace. This segment encompasses drinks marketed for their purported health or performance-enhancing attributes beyond basic hydration. The functional drink space has seen considerable growth in recent years. These drinks are fortified with juices, vitamins, and minerals, and can include sports and energy drinks, wellness beverages, and nutraceuticals. The development of many functional drinks aims to offer specific health benefits such as enhancing heart health, boosting immunity and digestion, or increasing energy levels [8].

Target markets for functional beverage products represent a diverse array of demographic groups. Manufacturers frequently customize and formulate beverages tailored to meet the distinct needs and preferences of specific consumer segments. By strategically adapting product offerings to address the requirements of targeted demographic profiles, functional beverage companies can optimize market fitness and appeal for their goods. This can include targeting drinks towards children, women, seniors, or other age and gender-specific groups.

### **The Role of Beverages in Nutraceutical Delivery**

Beverages offer an effective vehicle for delivering nutraceutical components, such as soluble fiber or herbal extracts, enhancing their nutritional value. Originating primarily from fruit and vegetable sources, nutraceutical beverages also derive from a variety of other plants including tea, coffee, cocoa, and soybean, in addition to animal-derived products like milk and dairy-based or even alcoholic drinks. The rich botanical diversity of India presents vast opportunities for innovation in nutraceutical beverages, leveraging the nutraceutical potential of traditional herbs. These herbs, widely consumed for refreshment and nutritional benefits during summer, underscore the health-enhancing properties of herbal-infused soft drinks [8].

## MATERIALS AND METHODS

### Selection and Collection of Herbs

In the development of the nutraceutical soft drink, key components were carefully chosen based on their health benefits and availability. The primary ingredients utilized included Ashwagandha root, Bael fruit, Ginger, Amla fruit, Turmeric, Mentha leaves and Black pepper. These ingredients, known for their nutritional and therapeutic properties, were sourced from local markets to ensure freshness and quality.

### Preparation of Extracts and Juices

Ashwagandha roots underwent a cold maceration process for seven days by using a hydroalcoholic solvent to extract its active components. For the incorporation of bael fruit, only fresh fruits were selected due to their higher nutritional value compared to their dried fruits. To enhance juice yield and stabilize the color, the bael fruit pulp was gently heated to 80°C before pressing, which also improved the juice's color stability and overall acceptability among testers [8].

Amla, known for its high vitamin C content, was processed by crushing the fresh fruits to obtain juice, ensuring the preservation of its nutritional properties.

### Preparation of Nutraceutical Soft Drink

The herbal soft drink involved experimenting with various ingredient blends and taste enhancers at differing concentrations to achieve a palatable recipe. The selection and proportion of extracts and juices incorporated were determined according to their recommended daily intake values. Initial trials were carried out to assess the beverage's acceptability, varying the mix and amount of flavor enhancers. The optimal recipe identified from these trials was then carbonated using a carbonation machine. Carbonation is known to significantly reduce the likelihood of mold and bacterial proliferation in beverages, as these microorganisms are generally intolerant to high levels of carbon dioxide (CO<sub>2</sub>). Following carbonation, the herbal soft drink was bottled for subsequent evaluation in terms of its sensory appeal, nutritional content, and shelf-life stability [9].

After conducting preliminary trials, the final formula for a nutraceutical herbal soft drink was developed. Addition of salt was found to enhance the taste and to lower the sourly flavor of fruits. Based on preliminary sensory evaluation, compositions of the final nutraceutical soft drink with honey as a sweetener were developed (Table 1) [10].

**Table 1.** Composition of nutraceutical soft drink.

Batch	Ashwagandha Extract	Bael Juice	Ginger	Turmeric	Amla Juice	Mentha Leaves	Black Pepper	Honey	Salt
F1	1% w/v	25% v/v	10% w/v	10% w/v	15% v/v	2% w/v	1% w/v	10% v/v	0.002% w/v
F2	1 % w/v	50% v/v	10% w/v	10% w/v	15% v/v	2% w/v	1% w/v	10% v/v	0.002% w/v
F3	1 % w/v	25% v/v	20% w/v	10% w/v	15% v/v	2% w/v	1% w/v	10% v/v	0.002% w/v
F4	2 % w/v	25% v/v	10% w/v	10% w/v	15% v/v	2% w/v	1% w/v	10% v/v	0.002% w/v
F5	2 % w/v	50% v/v	20% w/v	10% w/v	15% v/v	2% w/v	1% w/v	10% v/v	0.002% w/v
F6	2 % w/v	50% v/v	10% w/v	10% w/v	15% v/v	2% w/v	1% w/v	10% v/v	0.002% w/v

### Evaluation of Nutraceutical Soft Drink

1. *Quality evaluation* [11]: The quality assessment of the formulated nutraceutical soft drink was crucial to ensure its effectiveness and safety. This study involves both physicochemical and phytochemical evaluations of the samples, comparing the results to established industry standards. Sensory analyzes were performed to assess characteristics such as appearance, aroma, flavor, texture, and auditory attributes. Additionally, we examined the freshly prepared drink for microbial contamination during production, specifically assessing the total yeast and mold counts and ensuring the absence of harmful bacteria. These evaluations were conducted following

- pharmacopeial methods.
- Sensory evaluation* [12]: Sensory evaluation was conducted using a nine-point hedonic rating scale with a panel of five individuals. This study evaluated the nutraceutical soft drink's appearance, color, taste, flavor, consistency, and overall acceptability.
  - Physicochemical and phytochemical analysis* [13]: Several physicochemical parameters, including pH, titratable acidity, and total soluble solids were analyzed. Additionally, the prepared beverage underwent evaluation for carbohydrates, proteins, glycosides, tannins, polyphenols, and flavonoids using standard procedures [14, 15]. Phenolic content was determined using the Folin Ciocalteu assay evaluated as gallic acid equivalent. Total flavonoid content was measured using the aluminum chloride colorimetric method [16].
  - Reaction of soft drink on human nails and teeth* [14]:
    - For nails*: Mark porcelain dishes. Put measured single nail in each porcelain dish. Add 20 ml soft drink in all samples and note observation.
    - For teeth*: Take five porcelain dishes. Weigh the teeth and place them into each of the five dishes. Add 20 ml of soft drink to each dish, then observe the teeth. After a few days, weigh them again [15].
  - pH identification* [16]: The pH of the energy drink was measured utilizing a calibrated digital pH meter at a constant temperature, then the pH value was recorded.
  - Antioxidant potential* [17]: Antioxidants are substances that scavenge for free radicals, thereby preventing harm caused by such free radicals. The antioxidant potential of the soft drink was measured in vitro by 1, 1-diphenyl-2-picryl-hydrazyl (DPPH) assay. The free radical scavenging activity was evaluated using a slightly modified methodology.
  - Stability testing* [18]: An organoleptic, physicochemical, and phytochemical analysis was conducted on a prepared soft drink every 15 days throughout a three-month storage period. The analysis examined potential changes in sensory characteristics like taste, color, and aroma as well as physical and chemical properties and phytochemical components during the storage period.

## RESULTS AND DISCUSSION

Based on the trials of all six formulations, the formulation F5 for the nutraceutical herbal soft drink was finalized. The addition of salt improved the taste and reduced the tartness. After the initial sensory evaluation, the composition of the final nutraceutical soft drink was formulated with honey as the sweetener (Tables 2 and 3).

**Table 2.** Extractive yield/juice yield of herbs.

Herb	Extractive Yield/Juice Yield
Ashwagandha extract	2.7gm/100g of powder
Bael juice	55 ml/100g fruit pulp
Ginger	15ml/100g Rhizome
Turmeric	3.2gm/100g of powder
Amla juice	45 ml/100g fruit pulp
Mentha leaves	1.2gm/100g leaves

**Table 3.** Optimized herbal soft drink.

S.N.	Ingredients	F5
1.	Ashwagandha extract	2% w/v
2.	Bael juice	50 %v/v
3.	Ginger	20% w/v
4.	Turmeric	10% w/v
5.	Amla juice	15% v/v
6.	Mentha leaves	2% w/v
7.	Black pepper	1% w/v
8.	Honey	10% v/v
9.	Salt	0.002% w/v

### Sensory Evaluation

Sensory evaluation was conducted on a fresh soft drink to assess various parameters, including color, taste, flavor, and overall acceptability at room temperature. The findings from these assessments are detailed in Table 4.

**Table 4.** Sensory parameters.

S.N.	Parameters	F5
1.	Color	Brownish
2.	Odor	Pleasant
3.	Taste	Sweet
4.	Overall acceptability	Favorable

### Physicochemical and Phytochemical Analysis

To evaluate the nutritional suitability of the formulation, various physicochemical and phytochemical parameters were assessed. The pH of the freshly prepared nutraceutical soft drink was measured at 5.3. The total soluble solids content of the drink was 18%, determined using a refractive index to Brix conversion chart. The vitamin C content was found to be 2.0 mg/ml, attributable to the inclusion of fresh amla, which is rich in this essential antioxidant.

Phytopharmaceuticals, being complex mixtures of numerous constituents, are variable and challenging to characterize. Preliminary phytochemical analysis of the fresh nutraceutical herbal soft drink indicated the presence of alkaloids, carbohydrates, proteins, tannins, flavonoids, and phenolics. The total phenolic content was determined to be 86 mg/100 ml, expressed in terms of gallic acid equivalent. The high phenolic content underscores their significant nutritional and physiological roles as bioactive substances. Additionally, the total flavonoid content was determined to be 75 mg/100 ml, using a standard curve and expressed as rutin equivalent. Given that the average daily intake of flavonoids ranges between 70–170 mg, consuming 100 ml of this drink would sufficiently meet the average daily requirement to help combat chronic diseases.

### Reaction of Soft Drink on Human Nails and Teeth

Initially all nails were white and strong (Table 5).

#### For teeth

Initially all teeth were white and strong (Table 6).

**Table 5.** Observations of Samples Over Time on nails.

Sample	Observation after 30 Hours	Observation after 70 Hours	Observation after 4 Days	Observation after 15 Days
Sting	Red color	Red color, Weaker	Red	Needle like thin nail, very red
Mountain dew	Green color	Yellow, Weaker	Yellow nail	Needle like thin nail, Yellow
Coca cola	Little black	Brown, black	Dark black nails, so many powders are flowing.	Very small and narrow piece of nail. Very much suspension and mud.
Water	No change	No change	No change	No change
Herbal soft drink	No change	No change	No change	No change

- Coca-Cola showed a dramatic reaction, accumulating a significant amount of mud and powder in a porcelain dish within just four days. Similarly, teeth exhibited a strong reaction to Coke.
- Sting transformed a nail into a needle-like shape and had a reaction with teeth too.
- Mountain Dew had the least reaction with both nails and teeth.

- The herbal soft drink did not react with either teeth or nails.

**Table 6.** Observations of Samples Over Time on teeth.

Sample	Initial Wt. (gm)	Wt. after 5 Days (gm)	Change in Wt. (gm)	Color Change
Sting	1.50	1.43	5%	Red
Mountain dew	1.65	1.58	3%	Green
Coca cola	2.41	2.19	9%	Very black
Water	1.30	1.30	0%	No change
Herbal soft drink	1.75	1.75	0%	No change

### Antioxidant Activity

The beverage was identified as a substantial source of phenolics and flavonoids, contributing to its antioxidant capacity. The DPPH antioxidant assay showed that the fresh summer nutraceutical beverage exhibited a 72.55% radical scavenging activity. Moreover, no notable decline in its antioxidant activity was observed over a storage period of three months.

### Stability Studies

During the storage period, there was a slight decrease in pH below 4. Typically, the pH of most commercially available soft drinks ranges from 3 to 4.5. The pH level significantly influences the resistance of bacterial spores to heat, with the highest resistance occurring at pH values of 6 and 7. Products are effectively preserved at low pH levels. The observed decrease in pH might be due to an increase in acidity as organic acids are converted. The study found little to no meaningful reduction in total soluble solids (TSS) during the storage period. The microbial count of the prepared drink was less than 30 cfu/ml after 15, 45, and 90 days, which is within the acceptable range according to APHA guidelines. Therefore, the prepared drink remained stable without any chemical preservatives for three months under refrigerated conditions. The antimicrobial properties of the herbs used, such as bael, ginger and mentha, also contributed to preservation by inhibiting microbial growth.

### CONCLUSION

The nutraceutical soft drink developed in this study offers a natural alternative to synthetic beverages, providing numerous health benefits. It is noteworthy that all the herbs utilized in this formulation are readily accessible during the summer season and are cost-effective, making the product economically viable.

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### Declaration of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

### Data availability Statement

The authors confirm the data supporting this study's findings are presented in this article.

### Credit Authorship Contribution Statement

DM: Supervision, Collection of drugs, and Formulation optimization. GS: experimental part and Conceptualization. SP: Analysis and writing – original draft. Pg: Writing – review & editing. Supervision.

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