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Effect of shanina enriched with Cumin Cuminum cyminum

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Abstract

The development of functional dairy beverages has gained significant attention due to their potential to deliver health-promoting compounds in a natural and palatable form. Shanina, a traditional fermented milk drink, is valued for its probiotic content and digestive benefits. Enriching shanina with Cuminum cyminum (cumin) offers an innovative approach to enhancing its nutritional, sensory, and functional properties. This study explores the effects of cumin enrichment on the physicochemical, microbiological, and sensory characteristics of shanina.

Cumin is known for its rich composition of essential oils, phenolic compounds, and minerals, which contribute to its antioxidant, antimicrobial, and digestive-stimulating properties. When incorporated into shanina, cumin may improve the beverage's antioxidant capacity, extend its shelf life by inhibiting spoilage microorganisms, and enhance its flavor profile with a distinctive aromatic note. The synergistic interaction between the probiotics in shanina and the bioactive compounds in cumin can further promote gut health and overall well-being.

The findings suggest that cumin-enriched shanina can serve as a functional beverage with improved nutritional value, sensory appeal, and potential health benefits. This formulation aligns with current consumer trends favoring natural, health-oriented products and highlights the potential of traditional dairy drinks as carriers for bioactive plant ingredients.

The increasing demand for functional foods has encouraged the development of dairy-based beverages enriched with natural bioactive ingredients. *Shanina*, a traditional fermented milk drink widely consumed in Middle Eastern countries, is recognized for its probiotic content, refreshing taste, and digestive benefits. The enrichment of shanina with *Cuminum cyminum* (cumin) presents a novel approach to improving its nutritional, functional, and sensory qualities. This study investigates the impact of cumin supplementation on the physicochemical composition, microbial activity, antioxidant potential, and sensory attributes of shanina.

Cumin seeds are a rich source of essential oils, phenolic compounds, flavonoids, and minerals such as iron, calcium, and magnesium. These bioactive constituents contribute to cumin's well-documented antioxidant, antimicrobial, anti-inflammatory, and digestive-enhancing properties. Incorporating cumin into shanina not only enhances its flavor and aroma but also increases its functional value by introducing natural antioxidants and antimicrobial agents.

Keywords:

Shanina, cumin, functional beverage, fermented milk, probiotics, functional foods.

Introduction

In recent years, there has been a growing global interest in functional foods and beverages that provide health benefits beyond basic nutrition. Consumers are increasingly seeking natural, [41] minimally processed products enriched with bioactive compounds that promote overall well-being. Fermented dairy beverages, such as shanina, have long been recognized for their nutritional richness, probiotic content, [43] and positive effects on digestive health. Traditionally consumed in Middle Eastern and Mediterranean regions, shanina is a refreshing, slightly sour drink made from fermented milk or yogurt diluted with water and sometimes flavored with salt or herbs. The incorporation of medicinal plants and spices into fermented dairy products has emerged as a promising strategy to enhance their functional and sensory properties. Among these, Cuminum cyminum (commonly known as

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cumin) stands out due to its wide range of pharmacological activities [39]. Cumin seeds are rich in essential oils, phenolic compounds, and minerals such as iron, calcium, and magnesium. These bioactive constituents contribute to cumin's antioxidant, antimicrobial, anti-inflammatory, and digestive-stimulating effects, which have been well-documented in both traditional medicine and modern scientific research. Enriching shanina with cumin not only enhances its flavor profile—adding a warm, earthy, and slightly spicy note—but also increases its nutritional and therapeutic potential. The combination of probiotics from the fermented milk and phytochemicals from cumin may create a synergistic effect, improving gut health, boosting immunity, and protecting against oxidative stress. [29] Moreover, cumin's antimicrobial properties may help extend the shelf life of the beverage by inhibiting the growth of spoilage microorganisms. From a technological perspective, the addition of cumin to shanina can influence its physicochemical characteristics, such as pH, acidity, viscosity, and microbial composition [28]. These changes can affect both the quality and stability of the final product. Therefore, studying the effect of cumin enrichment on shanina is essential to optimize its formulation, ensure consumer acceptability, and validate its functional benefits. [33] In summary, the enrichment of shanina with Cuminum cyminum represents an innovative approach to developing a functional dairy beverage that merges traditional fermentation with the health-promoting properties of natural spices. This combination aligns with current trends in functional food development, offering a product that is both nutritious and appealing to health-conscious consumers [46]

Functional foods

Functional foods have received increasing attention from the scientific and public health communities due to their ability to provide physiological benefits beyond their basic nutritional value. International bodies such as the European Food Safety Authority (EFSA), the US Food and Drug Administration (FDA), and the World Health Organization (WHO) [58]. Define functional foods as those containing biologically active ingredients that may contribute to the prevention and management of chronic noncommunicable diseases, including cardiovascular disease, type 2 diabetes, and certain types of cancer. The evolving model of "food as medicine" reflects a broader shift in nutrition science toward proactive, health-focused dietary strategies. [49]. Functional foods are also considered dietary supplements, as they provide additional health benefits alongside their nutritional value [24].
Fortifying foods with bioactive enhancers are one way to modify foods to make them more beneficial [38] as demand for bioactive enhancers in commercial food products has increased due to their health benefits and nutritional impact [15]. This has stimulated the emergence of an industry focused on the diverse applications of probiotics in food, leading to the creation of a new generation of "probiotic-rich health foods." These foods contain a large number of live probiotic strains. Dairy products are a prime example of this, with probiotics being abundant in many commercial dairy products, including yogurt, fresh milk, cheese, whey, and others. Dairy products play a crucial role in delivering probiotics to the human body, as they provide a suitable environment for their growth and survival. [22].
Functional foods represent a promising strategy in addressing the complex challenge of noncommunicable diseases, offering the potential to improve health outcomes and reduce disease risk through dietary diversification. In addition to their basic nutritional value, they contain biologically active compounds that can modify physiological functions and contribute to the prevention of chronic diseases. According to regulatory and scientific bodies such as the European Food Safety Authority (EFSA), the US Food and Drug Administration (FDA), and the World Health Organization (WHO), functional foods may be natural or modified to enhance their health-promoting properties.
[23] defined functional foods as those foods that have positive effects on health in addition to their traditional nutritional value. Fermented dairy products are among the most popular functional foods in Europe and are used to restore the intestinal flora of the digestive system, while the US National Academy of Sciences Food and Nutrition Board (National Academy of Sciences Food and Nutrition) Board defines functional foods as foods that support human health more than traditional foods containing them [35]. Functional foods were initially defined as natural or synthetic foods containing specific amounts of known or unknown bioactive substances that could provide health or therapeutic benefits and contribute to the prevention of chronic diseases. In 2014, the definition of functional foods was amended to include natural or artificial foods containing specific amounts of known or

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unknown bioactive substances, which must be non-toxic and capable of providing health or therapeutic benefits and preventing certain chronic diseases [7].

Dairy products

Lactic acid bacteria have been used in the production of fermented foods, and interest has increased in developed countries due to the health benefits obtained. [20] confirmed that consuming dairy products fermented with lactic acid bacteria (LAB) can control cardiovascular diseases, improve mental health, reduce lactose intolerance, break down phytic acid (an inhibitor of mineral absorption in the intestine), and improve the balance of intestinal microbes.

[3] confirmed in their study on the manufacture of dairy products using lactic acid bacteria, in addition to their role in fermentation and their ability to lower cholesterol levels.

The demand for therapeutic fermented dairy products has increased in recent years due to the development of their manufacturing processes and the belief in the importance of the health-beneficial substances they contain [23] They also confirmed [27]. Beneficial bacteria resist and expel toxins and strengthen the immune system and can maintain the vitality of starter bacteria for 35 days by adding *Lactobacillus acidophilus*, a type of probiotic bacteria that can be added to fermented milk and loves high acidity. They pointed out [44] that human consumption of dairy products fermented by bacteria helps reduce heart blood pressure in some adults, as proteins in fermented dairy products are broken down into small peptides, which increases their vitality and the body's ability to digest them. These peptides are absorbed in the intestines, thus causing a reduction in blood pressure. Consumption of therapeutic dairy products can also improve difficult immune functions [32].

Yogurt

Yogurt is one of the most popular fermented milk products, widely accepted around the world for its health and nutritional benefits, which have been known for centuries. Yogurt dates back to 6000 BC, when it was discovered by accident when milk was stored in sheep and cow skin bags. Over the centuries, the commercial curdled milk industry has evolved, paving the way for many commercially available varieties with a range of flavors, textures, tastes, and shapes [57].

Yogurt is also defined as a food produced by mixing a group of microorganisms that produce lactic acid, namely Streptococcus thermophiles and Lactobacillus bulgaricus [21] as it contains one or more dairy ingredients, namely skimmed milk and cream, as well as one or more other selected ingredients such as skimmed milk, vitamins, lactose, lactalbumin, lactoglobulin, or whey, either completely or partially removed, or mineral salts for the purpose of increasing solids [51].

Curdled milk has high nutritional value because it contains essential amino acids such as linoleic acid, linolenic acid, and arachidonic acid, as well as mineral salts that are beneficial to human health. There are several factors that affect the production of curdled milk, including storage time, the amount of starter added to the milk, incubation time, bitter taste, and curdling. The bitter taste is caused by increased acidity above 0.9%. These defects can be avoided by following the correct methods in the curd cheese manufacturing process [45]. Yogurt has positive effects when consumed, as it reduces the risk of diabetes and also has effects on body composition and weight and has heart-protective properties [10]. Yogurt is produced by fermenting different types of milk with bacteria such as Streptococcus thermophiles, Lactobacillus acidophilus, Lactobacillus bulgaricus). Some types of yogurts are enhanced with probiotic strains such as Bifidobacterium spp. to give yogurt health benefits when consumed [16]. Recently, there has been an increase in demand for low-fat yogurt due to its nutritional and therapeutic properties.

Reducing fat can lead to defects in curd, including poor texture, increased rind clarity, lack of flavor, and weak consistency [8] Several studies have been conducted to improve the physical, rheological, and structural properties of low-fat curd by adding stabilizers to milk, which increases the viscosity of curd and reduces these defects [5].

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Shinina

This is the name given to diluted milk without added flavorings. (regular milk drink). Milk drinks to which flavorings such as menthol, mint, or cumin have been added, or various natural flavorings such as aromatic herbs, twigs, etc., are called flavored milk drinks. [1]**.** There are also types of carbonated/non-carbonated milk drinks, or heat-treated/ or non-heat-treated, which are those that contain or do not contain carbon dioxide. Diluted milk drinks may be produced and offered as powder (dried milk drinks) for special uses and requests, according to the regional standard for milk drinks numbered CXS 332R - 2018 for the year 2018)

Diluted milk drink is a traditional drink in Turkey and other countries, served cold, especially in the summer. It is known by different names in different countries, for example, "dogh" in Iran, 'lasi' in India, and "ayran" in Turkey. Its chemical composition depends [31].

on the type of milk used, the fat content, and the amount of water added

Yogurt is defined as a fermented milk product produced by adding water to homemade yogurt or by adding *Lactobacillus delbrueckii ssp* and

Streptococcus thermophilus to fermented and pasteurized milk. It is produced [13] industrially in two different ways:

either by adding water to curdled milk or by adding water to homogenized and pasteurized milk first and then fermenting it [2]. In the first method, sufficient water is added to the fermented milk until the total solids content of the fermented sample reaches 8%. Salt (0.5%) is then added, and it is also obtained from milk mixed with water (50-30%) and salt at a concentration of (0.5-1%). The pasteurized milk was inoculated with microbial cultures (S. thermophilus and L. delbrueck ssp. Bulgaricus) and then incubated until a pH of 4.4-4.2. The fermented samples are then cooled to terminate fermentation and develop acidity [18].

Nutritional and therapeutic properties of yogurt

Yogurt is a good food for adults and children alike. It is easy to digest and beneficial for people with lactose intolerance (those who cannot consume lactose and suffer from intestinal disorders, severe gas, and diarrhea after drinking milk). Studies have shown that yogurt inhibits the bacterial germs that cause food poisoning and disease, confirming that yogurt can prevent dysentery. Studies have also confirmed that yogurt strengthens the immune function of the body's cells [14].

The production and consumption of yogurt is constantly increasing due to its therapeutic properties and nutritional value [54]. The health benefits of yogurt are due to the growth or presence of lactic acid bacteria in it, which protect the body from intestinal disorders and facilitate the digestion of lactose, as the starter bacteria convert a large part of the lactose into lactic acid, lower blood cholesterol, improve immune function, and aid in protein digestion and calcium absorption [19].

Milk and yogurt contain vitamins and minerals, with a few exceptions. During fermentation, starter bacteria consume both vitamin B12 and vitamin C and produce folic acid. There are differences between milk and yogurt in terms of their content of other vitamins, depending on the type of bacteria used In fermentation, although milk and yogurt are similar in terms of mineral content, some minerals, such as calcium, are more bioavailable in yogurt than in milk. In general, yogurt contains less lactose than milk, but it contains higher levels of lactic acid, lactose peptides, free amino acids, and free fatty acids [9]. Metchnikoff stated that Lactobacillus bulgaricus L. eliminates toxins produced by putrefactive bacteria in the human intestine by producing acidity and bacteriocins and competing with them in large numbers (Metchnikoff, 1908). Numerous studies and research projects have been conducted to determine the health effects of lactic acid bacteria. In all of these studies, various types of lactic acid bacteria and different methods of action were used, and researchers concluded that the positive effect of lactic acid bacteria is due to their immune effect, as they act as an agent against immunological antigen [59].

Numerous studies have confirmed that the health effects of lactic acid bacteria and yogurt are due to changes in the microbial content of the intestine, where there is an increase in the number of lactic acid bacteria that work to eliminate the growth of pathogenic bacteria, thereby reducing the chances of infection and disease and increasing the anti-cancer effect [25].

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The immune effect of lactic acid bacteria depends on their association with lymphocytes, as lactic acid bacteria resist pathogenic bacteria, which activates lymphoid tissue, leading to the production of cytokines and antibodies and increased immune cell activity. In humans, cytokines are produced and phagocytic activity is activated. bacterial phagocytosis, antibody production, and natural killer cell activation. All of these effects are observed when yogurt consumption increases or cells are exposed to lactic acid bacteria [36].

The benefits of milk due to the activity of lactic acid starter bacteria can be summarized in the following points: - Reducing blood cholesterol and aiding digestion through the production of special enzymes by starter bacteria and reducing the number of unwanted bacteria in the intestine, thereby helping to eliminate causes of disease such as colitis, intestinal colic, and diarrhea.

It also lowers blood pressure, strengthens immunity, and produces antibodies that help inhibit pathogenic bacteria, reduce carcinogenic compounds, reduce the toxicity of hazardous compounds added to food, help eliminate odors and gases, and help relieve anxiety, nervous tension, and psychological stress.

It also produces B-complex vitamins and increases calcium metabolism [47].

Cumin

Cumin (*Cuminum cyminum L.*) is one of the most important spice and medicinal crops in the world, belonging to the Apiaceae (Umbelliferae) family. It originated mainly in Egypt five million years ago and is widely cultivated in the hot and dry tropical and subtropical regions of the world, mainly in India, China, Iran, Syria, Turkey, the United Arab Emirates, and Egypt [37]. India is the main producer and source of cumin for Brazil, Japan, the United Kingdom, the United States, the United Arab Emirates, and others, and plays an important role in terms of area, production, exports, and consumption. Cumin is cultivated on an area of 8.42 lakh hectares, with a total production of 5.47 lakh tons in India, accounting for 70% of the global market share [12]. In the Indian states, Rajasthan and Gujarat are the largest producers, contributing about 90% of the total cumin production, and it is also grown in another state as a seasonal crop in the spring. Figure (1) Total cumin exports continued to increase (1.84 lakh metric tons in 2023-2024) from 2010 to 2024. One of the main reasons for the high demand for cumin in the global market is its wide use in herbal medicine and cooking. [40]. Cumin seeds are known for their medicinal properties and aroma; therefore, they are used in many Ayurvedic and veterinary medicines [50].

Classification of *Cuminum cyminum L*

Kingdom	Plantae
Phylum	Tracheophyta
Class	Magnoliopsida
Order	Apiales
Family	Apiaceae
Genus	Cuminum Tourn. ex L.
Species	Cuminum cyminum L

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plant

Photo of cumin

Photo of dried cumin seeds

Figure (1) Taxonomic rank of *Cuminum cyminum L*

Its antioxidant properties have been found to be useful in treating various ailments such as diarrhea, indigestion, epilepsy, toothache, whooping cough, flatulence, dyspepsia, and jaundice [42].

However, the potential medicinal use of cumin for its benefits to humans has created a high demand in the global market. However, the availability of high-yielding varieties for medicinal use remains limited. Figure (2) The limited diversity of mechanisms is the main obstacle to the production of high-quality spice crops.

[56]. Therefore, cumin cultivation practices require improved agricultural tools and proper management to obtain a high-quality crop. However, the shortage of superior varieties with desirable agronomic and economic characteristics can only be addressed by using modern techniques [34].

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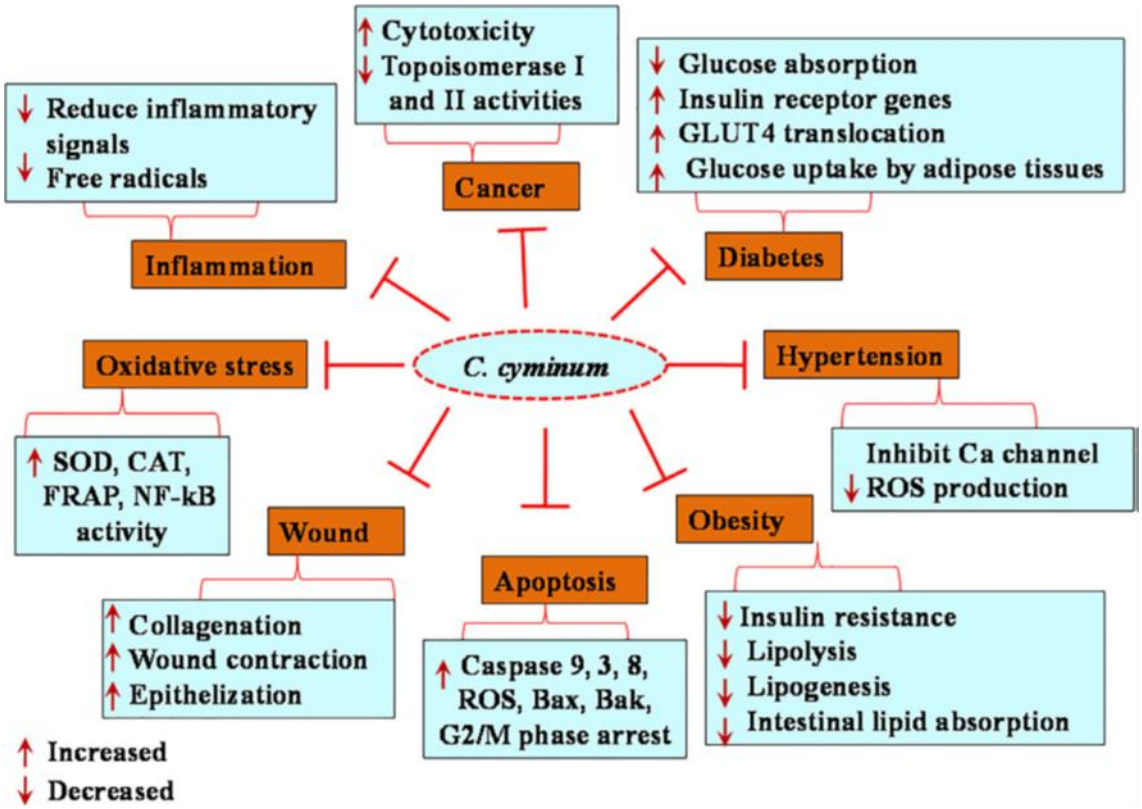

Figure (2) Nutritional and Health of *Cuminum cyminum L.* [55].

Nutritional and Health Value of Cumin

Cumin seeds have high nutritional potential and are widely used as a natural health tonic. They are used for a variety of purposes, including vegetables, nutrition, medicine, beverages, perfumes, cosmetics, and other industrial purposes as well. They contain a good number of vitamins, amino acids, minerals, and others, providing numerous health benefits. Table 1 [53] shows the nutritional composition of cumin seeds. This table shows that cumin has an important quantitative and nutritional composition, which not only gives this plant specific characteristics such as color, aroma, and taste, but also contributes to the development of herbal medicine for human health.

Natural products have always been a source of many biologically active substances, which have been recognized for their great therapeutic benefits since ancient times [48]. Since time immemorial, cumin seeds have been used in many traditional formulations and food preparations due to their distinctive and strong aroma and various medicinal properties. The seeds are antispasmodic, astringent, anticonvulsant, and diuretic [26]. Traditionally, the plant is recommended for treating stomach pain, indigestion, flatulence, hoarseness, toothache, high blood pressure, scorpion stings, weight loss, jaundice, diarrhea, etc. [4].

Cumin stimulates bile secretion, which speeds up digestion in ancient Greek medicine, cumin fruit was documented as a treatment for corneal opacity, ulcers, boils, colds, coughs, and infections.

In Indonesia, cumin paste is applied to the forehead to relieve headaches and is also used to prevent bloody diarrhea and rheumatism [52]. In Iran, this plant is traditionally used to stimulate milk production, relieve flatulence and pain, and as an excellent antispasmodic some clinical studies have also been conducted to verify the pharmacological effects of cumin. [11] demonstrated the ability of cumin to treat diarrhea through computer simulation studies. Kannan, Palani, Gunaseelan, Shyamaladevi, and studied the effect of cuminaldehyde on urinary protein levels. [17] There was a significant excretion of urinary proteins in diabetic rats treated with a high-fat

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diet (HFD) while urinary protein excretion was significantly reduced in hyperglycemic rats treated with coumarin (10 mg coumarin per kg body weight). Table (1) Although some of its popular medicinal uses have been scientifically verified, many traditional uses of this herbal compound still lack sufficient scientific approval in terms of safe dosage and duration of use. It is also necessary to determine the relationship between different age groups and the recommended safe dosage for a particular popular medicinal use. Future biological exploration studies should specifically evaluate the long-term effects of the cumin formula along with the potential for recurrence of disease symptoms after complete completion of the treatment period with this herbal remedy [6].

Major ingredients	Nutritional value	Major ingredients	Nutritional value
Energy	375 kcal	Folates	10 µg
Carbohydrates	44.24 g	Pyridoxine	0.435 mg
Protein	17.8 g	Niacin	4.58 mg
Cholesterol	0 mg	Thiamin	0.628 mg
Dietary fibers	10.5 g	Riboflavin	0.32 mg
Total fat	22.27 g	Vitamin E	3.3 mg
Sodium	1,788 mg	Vitamin A	1,270 mg
Potassium	68 mg	Vitamin C	7.7 mg
Calcium	931 mg	Vitamin K	5.4 µg
Iron	66.36 mg	Manganese	3.3 mg
Copper	0.867 mg	Phosphorus	499 mg
Magnesium	366 mg	Zinc	4.8 mg

Table (1) Nutritional value of *Cuminum cyminum L* [30]

Conclusion

The enrichment of shanina with Cuminum cyminum (cumin) demonstrates significant potential in enhancing the nutritional, functional, and sensory qualities of this traditional fermented dairy beverage. The incorporation of cumin introduces valuable bioactive compounds such as phenolics, flavonoids, and essential oils, which contribute to improved antioxidant and antimicrobial properties. These compounds not only enhance the beverage's health-promoting potential but also support the growth of beneficial lactic acid bacteria, improving microbial stability and extending shelf life.

From a sensory perspective, cumin imparts a distinctive flavor and aroma that increases consumer appeal when used at optimal concentrations. Physicochemical analyses indicate that cumin addition can influence parameters such as pH, acidity, and viscosity, contributing to a more stable and texturally appealing product.

Overall, cumin-enriched shanina can be classified as a functional dairy beverage that combines the probiotic benefits of fermentation with the therapeutic effects of natural plant compounds. This formulation aligns with current trends in functional food innovation, offering a nutritious, flavorful, and health-enhancing product suitable for modern consumers seeking natural alternatives to conventional beverages.

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