

The Emerging Role of Nutraceuticals in Functional Beverages

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Abstract

Nutraceuticals, derived from food sources, are gaining prominence for their potential health benefits beyond basic nutrition, often serving as remedies for chronic diseases. This includes functional beverages, such as energy drinks, sports drinks, nutraceutical drinks, and functional waters, which are formulated to provide specific health benefits, from energy enhancement to immune support. Nutraceutical beverages often contain bioactive compounds, vitamins, minerals, probiotics, herbal extracts, and adaptogens, offering a convenient way to address consumer health needs. Fermented beverages, particularly dairy-based ones, are also integral to the market, benefiting from the probiotic properties of lactic acid bacteria. The market for functional beverages is growing rapidly, with increased consumer awareness of their potential health benefits, particularly in countries like India, where traditional knowledge and modern health trends converge. Challenges in product formulation, stability, and regulatory approval persist, but the future of the nutraceutical beverage market looks promising, driven by innovations in sourcing, packaging, and consumer demand for healthier, plant-based options. The market is expected to experience robust growth, with an anticipated compound annual growth rate (CAGR) of 6% from 2022 to 2032.

Keywords: Functional food, functional beverages, phytochemicals, prebiotics, probiotics

INTRODUCTION

Nutraceutical is a term coined from “nutrition” and “pharmaceutics.” It refers to products extracted from herbal sources, dietary supplements (such as nutrients), specialized diets, and processed foods like cereals, soups, and beverages, which serve not only as nutritional sources but also as medicinal remedies.

In the United States, “nutraceutical” products are regulated as drugs, food ingredients, and dietary supplements. The definition of the term varies by country, but it is generally understood to refer to products derived from foods that are typically sold in medicinal forms rather than as conventional food items. A nutraceutical is often defined as a substance that offers physiological benefits or helps prevent chronic diseases.

Nutraceuticals, in contrast to pharmaceuticals, are substances that typically do not have patent protection. While both pharmaceutical and nutraceutical compounds may be used to treat or prevent diseases, only pharmaceutical compounds have regulatory approval.

A dietary supplement is defined as a product that contains one or more of the following ingredients: a mineral, a vitamin, an amino acid, a medicinal herb or other botanical, a substance used to enhance

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Received Date: December 14, 2024

Accepted Date: December 24, 2024

Published Date: January 29, 2025

Citation: Mohd. Wasiullah, Piyush Yadav, Shashikant Maury, Mohammad Osama. The Emerging Role of Nutraceuticals in Functional Beverages. Research & Reviews: A Journal of Medicine. 2025; 15(1): 16–24p.

the diet by increasing daily intake, or concentrate, metabolite, constituent, extract, or combinations of these components. Nutraceuticals are a category of these dietary supplements, specifically used for health-related purposes beyond basic nutrition (Figure 1) [1–3].

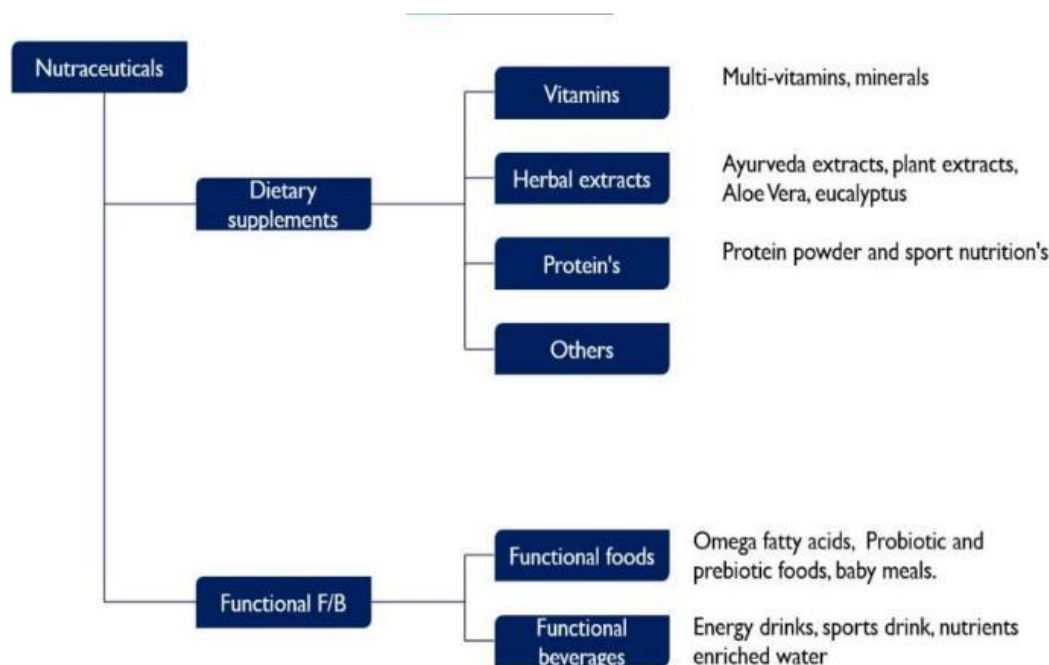


Figure 1. Overview of nutraceuticals – definition, classification, regulation, and distinction from pharmaceuticals.

FUNCTIONAL BEVERAGES

The human body contains approximately 100 trillion cells, each requiring 114 different nutrients and water daily. These nutrients come from various food sources. Water makes up about 60% of the human body, and a minimum of six glasses of water per day is necessary for proper hydration and survival. Recently, there has been growing interest in understanding the role of food consumption in disease prevention and its overall health benefits. This has prompted food manufacturers to focus on developing nutrient-rich functional foods and beverages. Globally, the functional beverage market is undergoing significant transformation. China, for instance, has emerged as the fastest-growing market for functional beverages, with a growth rate of 77%. In Europe, the non-alcoholic beverage sector represents approximately \$189 billion out of a total global market of \$500 billion.

Today, beverages are among the most significant functional foods due to their health benefits and their ability to meet consumer demands for nutrient content, convenient packaging, appropriate volume, size, design, ease of transportation and storage, and long shelf life. Beverages serve as excellent carriers and delivery systems for nutrients, bioactive compounds, antioxidants, vitamins, minerals, fatty acids, plant extracts, probiotics, prebiotics, micronutrients, and more. Functional beverages are liquid drinks that include aromatic plants or herbs, vitamins, minerals, and amino acids, as well as extracts from raw fruits or vegetables, and are primarily non-alcoholic in nature.

TYPES OF FUNCTIONAL BEVERAGES

There are four types of functional beverages.

1. Energy drink.
2. Sports drink.
3. Nutraceutical drink.
4. Functional water.

Energy Drink

Energy drinks are considered a type of functional beverage that typically contain a combination of key ingredients, such as caffeine, vitamins, carbohydrates, and other compounds that provide nutritional or physiologically stimulating effects [4]. Energy drinks are designed to provide a quick energy boost, enhance cognitive function, combat fatigue, and support alertness and endurance. The global market for energy drinks was valued at USD 39 billion in 2013 and is projected to grow to USD 61 billion by 2021 [5].

Sports Drink

Sports drinks are flavored beverages designed to help with rehydration during or after physical activity. These drinks typically contain carbohydrates in the form of sugars or low-calorie sweeteners and sometimes include vitamin B to enhance energy. They are formulated with essential minerals, such as sodium, potassium, chloride, calcium, phosphate, and magnesium [4]. In addition, sports drinks may contain low-calorie sweeteners, citric acid, and both natural and artificial fruit flavors. Primarily intended for athletes, these drinks provide a targeted combination of ingredients that help improve performance [6].

Nutraceuticals

Nutraceutical drinks are beverages derived from ingredients, such as fruits, vegetables, and plants, including tea, soybean, cocoa, and dairy-based products. These drinks are created from a variety of sources, offering a wide range of enjoyable flavors and health-promoting benefits. One of the key advantages of nutraceutical drinks is their ability to deliver one or more nutraceutical compounds in a single product. Additional benefits include convenience, easy storage, varying sizes and flavors, high acceptability, and relatively low cost. In response to current health concerns among consumers, nutraceutical drinks provide solutions targeting specific issues like brain health, heart health, energy enhancement, immunity, and beauty from within. Thanks to their antioxidant properties, these drinks also offer cardiovascular protection [7].

Functional Water

Functional water is essentially water (H₂O) that has been enhanced with added ingredients, such as oxygen, hydrogen, minerals, caffeine, or herbs, all of which are intended to provide specific health benefits. These added components can help boost energy levels, promote faster recovery after exercise, and reduce inflammation. When caffeine is included, the result is caffeinated water, which can improve memory and enhance focus [8].

FERMENTED BEVERAGES AND THEIR CHARACTERISTICS

Fermentation is a widely recognized technique for creating foods that are not only nutritious but also have enhanced health benefits and reduced disease risks. A variety of innovative approaches have been implemented to elevate the traditional fermented beverage industry, aiming to commercialize non-dairy fermented drinks made from ingredients, such as cereals, fruits, vegetables, soy, and more. It's not far-fetched to imagine a future where fermented beverages become a major component of the functional food sector [9].

Milk-based fermented yogurt-style drinks, with kefir being one of the most popular functional fermented dairy products in North America, and Ymer in Denmark and Western Europe, are prime examples. Dairy-based products account for 43% of the functional beverage market, with most of these being fermented items.

In North America and Europe, the fermented dairy and milk product market (such as yogurt) is valued at approximately €46 billion. In the Asian market, the same category holds a market share of about 77%. Naturally fermented dairy products with yogurt-like consistency are produced globally. These milk-based fermented drinks can be made from pasteurized or unpasteurized skim milk from various animals,

including cows, goats, camel, sheep, and yak, or even from non-dairy sources like coconut milk. The fermentation process involves specific starter cultures, backslopping, or natural fermentation methods.

Although milk-based fermented beverages primarily contain lactic acid bacteria (LAB), the precise composition of microflora can vary based on factors, such as the source and composition of the milk, the type of product being made, milk pretreatment, starter strains, the local environment, processing temperature, hygiene practices, container handling, and the duration of fermentation.

Fermented drinks made from different sources are popular around the world, and their preparation methods and local preferences contribute to a diverse range of functional beverages.

KEY NUTRACEUTICAL INGREDIENTS IN FUNCTIONAL BEVERAGES

Vitamin

In the context of functional beverages, vitamins are essential micronutrients that are added to drinks to enhance their health benefits. These nutrients play a crucial role in various physiological functions, such as immune support, energy production, antioxidant activity, and skin health. Functional beverages that contain vitamins aim to support overall well-being by providing a convenient source of these nutrients in addition to hydration.

Common vitamins found in functional beverages include

- *Vitamin C*: Known for its antioxidant properties, it supports immune health and helps with the absorption of iron.
- *Vitamin B complex (e.g., B1, B2, B6, and B12)*: These vitamins are involved in energy metabolism, brain function, and red blood cell production.
- *Vitamin D*: Important for bone health, immune function, and inflammation reduction.
- *Vitamin E*: An antioxidant that helps protect cells from damage and supports skin health.

Minerals

Minerals in functional beverages serve an important role in supporting health and wellness, as they provide essential nutrients that contribute to hydration, energy metabolism, bone health, muscle function, and immunity. Functional beverages enriched with minerals are often marketed to athletes, health-conscious individuals, or those needing specific nutrient support. Here are some commonly added minerals in functional beverages and their benefits:

Calcium

Important for bone and dental health Supports muscle contraction and nerve transmission. Often found in beverages aimed at supporting bone health, such as milk-based drinks, smoothies, and plant-based milk.

Magnesium

- Plays a role in over 300 biochemical reactions in the body, including energy production and muscle function.
- Supports relaxation and helps reduce muscle cramps.
- Common in beverages marketed for muscle recovery and stress relief.

Potassium

- Crucial for fluid balance, muscle contractions, and heart health.
- Help regulate blood pressure.
- Often included in electrolyte drinks and sports drinks to help replace potassium lost in sweat.

Sodium

- Help regulate fluid balance, nerve function, and muscle contraction. Important in small amounts,

particularly for rehydration.

- Found in sports drinks to replenish electrolytes after intense exercise but often balanced with potassium and other electrolytes.

Probiotics

Probiotics are commonly added to functional beverages for their potential health benefits, especially for gut health, immunity, and even mental well-being. Probiotics are live microorganisms that, when consumed in adequate amounts, can confer a health benefit on the host by balancing gut flora and supporting various bodily functions. Here is an overview of the role of probiotics in functional beverages.

Herbal Extract

Herbal extracts are another significant trend in functional beverages, driven by increasing consumer interest in natural, plant-based remedies. Herbs like ashwagandha, turmeric, ginseng, and green tea offer unique health benefits, and when incorporated into beverages, they create convenient and enjoyable ways for consumers to support their wellness. Here is an overview of how herbal extracts are being used in functional beverages, their benefits, and the challenges manufacturers face.

Adaptogens

Adaptogens are becoming a popular category in functional beverages, catering to consumers interested in natural ways to manage stress, enhance energy, and improve resilience. Adaptogens are natural substances, primarily herbs and mushrooms, that help the body adapt to physical, mental, and environmental stress. In functional beverages, adaptogens like ashwagandha, Rhodiola, ginseng, and reishi are used to create drinks that promote balance, focus, and overall well-being. Here is an overview of the benefits, popular adaptogens, and challenges of formulating adaptogen-based functional beverages.

The Health Benefits of Nutraceuticals Enhance Functional Beverages

A functional beverage is a non-alcoholic drink designed to provide specific health benefits in addition to its general nutritional value. These drinks can support various bodily functions and contribute to overall wellness when consumed regularly as part of a balanced diet.

Functional beverages are intended to improve physical health or reduce the risk of disease progression by delivering targeted health benefits, such as enhancing concentration and boosting memory

They go beyond basic nutrition by benefiting one or more body systems

Research indicates that lifestyle factors, such as poor diet, inactivity, and smoking contribute to the onset of chronic diseases. Addressing these behaviors could reduce the risk of heart disease and stroke by up to 80%, type-2 diabetes by 80%, and cancer by 40%.

Nutraceutical beverages, which are formulated to promote specific health outcomes, are commonly designed to support the heart, brain, immune system, and skin health, among other benefits.

Fruit-based functional drinks, for example, are rich in bioactive compounds that can help improve blood lipid profiles, reduce oxidative stress, prevent atherogenic modifications of LDL cholesterol, and increase HDL cholesterol levels. Functional waters and probiotic drinks can support healthy skin, hair, bones, and joints, as well as digestive health, immunity, and protein utilization. Probiotic teas are beneficial for digestive system health.

In the context of sports, functional beverages are also used to support both athletic performance and overall health. Sports drinks are often enriched with omega-3 fatty acids and CoQ10 to promote heart

health, fiber, and probiotics for gut health and weight management, collagen for improved skin appearance, and vitamins like D and minerals, such as zinc, to enhance immunity. Consumer interest in functional products, particularly those that support immune health, has surged, with as many as 75% of people now expressing a preference for such functional beverages (Euromonitor) (Figure 2).

Numerous studies have highlighted the promising effects of lactic acid bacteria (LAB) in significantly altering the gut microbiota and inhibiting the growth of harmful enteric pathogens. LAB strains are also known to enhance metabolic functions, boost the immune system, reduce the risk of colorectal cancer, help regulate serum cholesterol levels, and eliminate harmful toxins that may be present in raw or processed foods. The overall health benefits of LAB can be further explained as well.

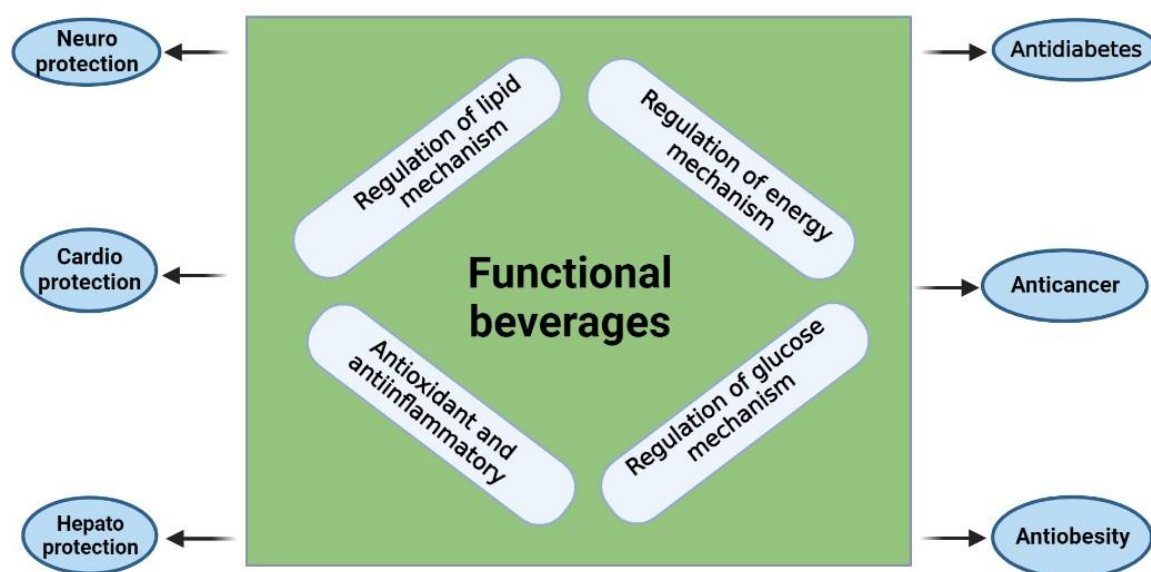


Figure 2. Health-promoting effect of functional beverages.

Health Related Claims

Health claims refer to the relationship between a food, its components, and a specific disease or health-related condition. These claims are based on rigorous scientific evidence and broad scientific consensus. Currently, there are three main types of health-related claims:

- *Health claims*, which describe the connection between a food or its components and a specific disease or health condition.
- *Nutritional claims*, which indicate the nutrient levels in a food product, such as “high,” “low,” or “free,” or compare the nutrient content between different foods (e.g., “more” or “reduced”).
- *Structural/functional claims*, which describe the health-promoting or nutritional benefits of a product, are typically found on dietary supplement labels.

The success of nutraceuticals and functional foods is often influenced by the regulatory environment in which they are marketed. These regulations vary significantly from country to country, particularly regarding the composition and labeling of such products. In India, nutraceuticals are typically categorized as foods for special dietary use, which include plant and animal extracts, vitamins, minerals, and proteins. The *Food Safety and Standards Act (2006)* governs the production and marketing of nutraceutical and functional foods in the country [10].

Technological Challenges

Gushing refers to an undesirable occurrence in carbonated beverages, where the drink suddenly foams over shortly after opening, even if the container has not been shaken. This phenomenon is especially common in natural drinks, particularly those with a high juice content. By carefully selecting

raw materials and processing the juices using purely physical (natural) filtration methods, gushing can be effectively controlled, minimizing the risk [11–14].

Consumers expect a fresh taste and balanced sensory experience from a drink throughout their life, up to the recommended "best before" date. Some flavor components are more delicate and require special care, especially those in beverages with citrus flavors [15–17].

With the expert preselection of appropriate flavors by our AUSTRIA JUICE flavor specialists, we can recommend the ideal flavor for each specific application. However, the reasons behind taste changes over time are complex and need to be considered from multiple perspectives. Additionally, the choice of packaging – whether it's a can, glass bottle, or PET bottle – and the filling process must also be factored into the overall assessment of long-term product stability [18].

Nutraceuticals and Functional Foods Market in India

The growing consumer awareness of healthy foods has propelled functional foods into global markets, where they have quickly gained significant market share over the past few decades. The nutraceuticals market, which includes dietary supplements, sports and energy drinks, bodybuilding aids, and weight loss products, is expanding rapidly. In 2013, the global nutraceutical market was valued at \$160.6 billion, increasing to \$171.8 billion in 2014. By 2019, this market is projected to reach \$241.1 billion, with a compound annual growth rate (CAGR) of 7.0% from 2014 to 2019 [19].

In India, consumer health and fitness awareness, along with a growing willingness to invest in health-oriented foods and supplements, has led to the rapid growth of the nutraceuticals and functional foods market. The Indian nutraceuticals market can be broadly divided into dietary supplements (32%) and functional foods and beverages (68%). The increasing popularity of functional foods in India is largely driven by the country's reliance on Ayurveda and traditional knowledge, coupled with a rising middle class, which has increased purchasing power. Currently, the Indian nutraceutical market is valued at around USD 2.2 billion. The southern states, particularly Tamil Nadu and Andhra Pradesh, along with West Bengal and the eastern regions, are key markets for nutraceuticals.

The Indian nutraceutical market is expected to grow at a rate of 20%, reaching \$6.1 billion by 2019-2020. The market for fortified foods is also anticipated to expand rapidly, with a projected CAGR of 21.7% by 2018. Vitamins and minerals dominate around 36% of the Indian nutraceutical market, followed by probiotics at 9%, and omega-3 fatty acids, which account for 5% of the market.

Major companies in the vitamins and minerals market include DSM, BASF, and Merck, with DSM leading the omega-3 fatty acids market. The probiotic market, on the other hand, is primarily dominated by major companies specializing in probiotic products [20].

FUTURE AND SCOPE

The functional beverage sector holds significant growth potential due to rising consumer demand and increased awareness about health and nutrition. These beverages, which are widely consumed across the globe, make up one of the fastest-growing segments within the functional food industry. This sector includes a broad range of products, such as dairy, no-dairy, fruit-based, and herbal beverages. As a result, the functional beverages market is set to become one of the largest and most rapidly expanding food markets in the coming years, with new products constantly being introduced due to their growing popularity.

Recent market trends have highlighted the rising demand for healthy beverages, with an increasing number of consumers seeking functional drinks to improve their health. Milk-based functional beverages are viewed as ideal vehicles for bioactive ingredients that target lifestyle-related diseases. One notable emerging product in this category is cereal grain-based milk, which has gained popularity

worldwide. Compared to cow's milk, cereal milk is lactose-free, hypoallergenic, and rich in bioactive compounds with health benefits, all while being cost-effective and environmentally sustainable.

Looking ahead, the future of functional beverages is expected to include sugar-reduced or sugar-free options that are naturally formulated to support mood enhancement, and brain health, and align global trends of plant-based ingredients. Plant-based milk alternatives are projected to see significant growth, further expanding the food market. The future success of functional beverages will depend on factors, such as sensory appeal, shelf life, product stability, and the physiological benefits they offer.

In Japan, the market for functional foods has already surpassed that of foods for specified health uses (FOSHU) and even foods with health claims (FHC). The functional beverages market is highly fragmented, with many small- and medium-sized companies competing for market share. To gain a competitive edge, these players are focusing on developing functional beverages with diverse nutritional benefits and investing heavily in research and development, as well as pursuing mergers and acquisitions.

The increasing popularity of healthy, nutritious drinks has led to the emergence of various new categories, including functional teas, juices, sodas, and sparkling waters. The functional beverages market is projected to experience a compound annual growth rate (CAGR) of 6% from 2022 to 2032 [21, 22].

CONCLUSIONS

The nutraceutical and functional beverages market is rapidly expanding as consumer awareness of health and wellness continues to rise. Functional beverages, which encompass a wide range of products including energy drinks, sports drinks, nutraceutical drinks, and functional waters, offer an innovative solution to meet the growing demand for health-promoting, convenient, and nutrient-dense products. These beverages not only provide essential nutrition but also deliver targeted health benefits, such as improved cognitive function, heart health, immunity, and digestive support, among others.

The integration of bioactive compounds, probiotics, vitamins, minerals, and herbal extracts into functional beverages has opened new avenues for addressing modern health challenges. Fermented beverages, particularly those made from non-dairy sources like cereals and plant-based milk, are gaining traction due to their sustainability, health benefits, and ability to cater to lactose-intolerant or vegan consumers. Additionally, the increasing popularity of plant-based ingredients and the demand for sugar-reduced or sugar-free formulations are shaping the future of the functional beverage industry.

In countries like India, the rise of middle-class consumers, combined with a long-standing tradition of Ayurvedic medicine, is driving the growth of the nutraceutical market, making it a lucrative sector for investment. As the market continues to evolve, companies are investing heavily in research and development to create innovative products that align with consumer preferences for health-conscious, functional foods.

Overall, the functional beverages market is poised for continued growth, with emerging trends, such as fortified drinks, adaptogens, and personalized health solutions expected to dominate the landscape. With a projected annual growth rate (CAGR) of 6% from 2022 to 2032, the future of functional beverages appears promising, as consumers increasingly turn to these beverages to improve their overall well-being and reduce the risk of chronic diseases.

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