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Functional beverages: A boon for the society

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Abstract

The study aims to know about different types of functional beverages and its uses in different sectors. Here we know about the nutritional value, phytochemicals presence and medicinal properties of the functional beverages. The consumption of function beverages can help increases the immunity and protected us from different kinds of diseases. It is the fast growing segment in newer food product development category of functional and specialty beverages across the globe. It comes in good shape and size which helps carry and store the products. Now a days the various functional beverages industry are growing up due to its high demand. After COVID the demand of functional beverages has increased over the last year. The finding from this review will help to guide the development of functional product and increasing demand in future of it.

Keywords: Functional food, functional beverages, phytochemicals, bioactive compound

Introduction

Functional foods refer to those foods that contain different ingredients, which have certain functional or bioactive components that have physiological and health functions in addition to its fundamental function of providing nutrition, or food for specified health use. Functional foods were introduced in mid 1980s in Japan (Routray and Orsat, 2019, Mudgil and Barak, 2019)^[6, 2].

Nowadays Beverages are making an important contribution to nutritional intake and their health-related roles are taking much attention. They fulfill the consumer's demand in terms of size, shape, and storage, and they can contain the desirable nutrients. (Nazhand *et al.*, 2020)^[4] An important segment of functional foods is functional beverages that permit to include the specific and desirable nutrients and bioactive compounds, which preserve human hydration, have antiaging, energy supplying, relaxing, and beauty-enhancing effects (Dini, 2019)^[10]. When developing a functional beverage, the preferences and choice of ingredients depend on several factors including regulation of energy metabolism, improving antioxidant and anti-inflammatory response, providing neuro, cardio hepatoprotection, and contributing to cancer, diabetes, and obesity-satiety treatments (Akyuz *et al.*, 2019)^[8].

Functional beverages occupied over half (US \$99 billion) of the total market value (US \$168 billion) of functional foods in 2019 (Miroso *et al.*, 2020)^[16]. In India, the functional foods and beverage market is in its infancy and was between Rs. 46 billion and Rs. 49 billion in 2014-15. It was growing at 14-15 percent. (Arya *et al.*, 2018).

Types of functional beverages

Functional beverages can be classified into energy drinks, sports drinks, nutraceutical drinks, dairy-based beverages, and vegetable and fruit based beverages (Nazhand *et al.*, 2020)^[4].

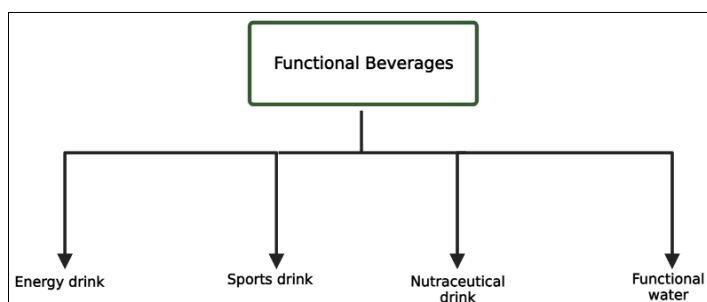


Fig 1: Types of Functional beverages

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Energy drink

Energy drinks are regarded as a type of functional beverage containing combinations of characterizing ingredients like taurine, caffeine, vitamins, carbohydrates and other substances with nutritional or enhanced physiological effects (Dini, 2019) [10]. Energy drinks help to provide an extra boost in energy, a cognitive enhancement, reverse fatigue effects, to maintain alertness, and endurance. The global energy drink market was worth USD 39 billion in 2013 and is forecast to reach 61 billion by 2021 (Shearer *et al.*, 2018) [24].

Sports drinks

Sports drinks are flavoured beverages that are formulated to help people to rehydrate during or after exercise. In sports drinks carbohydrates added in the form of sugar, and low-calorie sweeteners and sometimes contain vitamin B to boost energy. It is prepared using essential minerals like sodium, potassium chloride, calcium, phosphate, and magnesium etc. (Dini, 2019) [10]. Sports drinks may also contain low-calorie sweeteners, citric acid and natural and artificial fruit flavours (Pound and Blair, 2017) [29]. Mainly, sport drinks are for the athletes because they provide a specific amount of ingredients that helps to increase their performance.

Functional water

Functional water is simply H₂O with added altered chemicals like oxygen, hydrogen, minerals, caffeine or herbs that bring health benefits with target functions. It helps boosting the hydrogen which makes people promote energy, recover quickly after working out and reducing inflammation. After adding caffeine content will bring caffeinated water, which helps with improving memory and boosting concentration. It's useful for the young and adult who need a sound mind in the morning.

Nutraceutical drinks

Nutraceutical drinks have components from fruits, vegetables, and plants like tea, soybean, cocoa, and dairy-based beverages. Nutraceutical drinks are made from various resources and have many favourable tastes and healthy promotions. The benefit of this functional beverage is the ability to deliver one or several nutraceutical compounds in one product and the other benefits are convenience, storage capabilities, size and flavour variabilities, acceptability and relatively low cost (Naumovski *et al.*, 2021) [15]. In the current health concerns of consumers, nutraceutical drinks perform solutions for these specific concerns such as brain health, heart health, boosting energy, immunity and beauty from the inside out. Due to antioxidant activity nutraceutical drinks help render cardiovascular protection (Shahidi and Weerasinghe, 2003) [12].

Properties of functional beverages

Nutritional composition

Functional beverages are non-alcoholic drinks containing non-traditional ingredients like minerals, vitamins, amino acids, dietary fibres (DFs), probiotics, added raw fruits, etc. In cereal-based functional beverages have anthocyanin's, phytosterols, antioxidants and -3 fatty acids etc. (Doble *et al.*, 2019) [7]. The nutritive substances used in the functional beverages preparation are minerals, vitamins, amino acids (AA), and omega-3 (ω -3) and omega-6 (ω -6) fatty acids in different percentages, according to the product ingredient composition (Vinci *et al.*, 2019) [20]. In probiotic beverages have hetero-fermentative probiotic bacteria, Bifidobacteria which produce acetic acid and lactic acid. These acids limit the growth of pathogenic bacteria by reducing the intestinal pH. *L. casei* is the most preferable strain in the production of fruit-based fermented beverages. A typical green tea beverage contains 240-320mg of catechins, of which 60%-65% is EGCG, and 20-50mg of caffeine. Caffeine is by far the best-known compound in coffee. In a standard 8-oz cup of coffee can contain from 95 to 200mg of caffeine is present.

Phytochemicals properties

Phytochemicals found in common beverages: epigallocatechin (green tea), triterpenoids (citrus juices), resveratrol (red wine), xanthohumol (beer), procyanidin (chocolate), and caffeine (coffee), focusing on their molecular mechanisms, providing "ready to drink" prevention approaches (Bruno *et al.*, 2014). Cereal grains contain a diverse range of bioactive phytochemicals including phenolic compounds, dietary fibres, carotenoids, tocopherols, phytosterols, γ -oryzanol, and phytic acid and therefore have great potential for processing into functional beverages (Fang *et al.*, 2020) [5]. Tea samples showed antioxidant properties by the DPPH•, ABTS•+ and Br• free radicals scavenging assays and the carotene bleaching assay, caused by the presence of highly active ellagitannins (Chirikova *et al.*, 2016) [17]. The phytochemicals in brown rice beverages are dietary fiber, vitamin E, the B vitamins, unsaturated fats, γ -oryzanol, γ -amino butyric acid (GABA), antioxidants, phenolic compounds etc. (Merca *et al.*, 2012) [1]. Whey-based beverages contain lactoperoxidase, lactoferrin, α -lactalbumin, β -lactoglobulin, and thermostable fractions of protease peptones, bovine serum albumin, immunoglobulins, and bioactive peptides like phytochemicals (Tolun and Altintas, 2019) [9]. The organoleptic characteristics are necessary for new phytochemical sources and to substantiate the potential health benefits of these food ingredients to create a solid scientific knowledge base for their proper application in the promotion of health and the functional properties of phytochemical sources also crucial in order to obtain quality products.

Table 1: Phytochemicals with their sources and health benefits

Sources	Phytochemicals	Health benefits	References
Milk based	prebiotic, probiotic, dietary fiber, phytosterols, MUFA, PUFA, proteins, minerals, vitamins	Maintaining good intestinal micro flora, Lowering the cholesterol levels in body, Alleviation of lactose intolerance symptoms, prevention of diarrhea, Prevention of colon cancer, and Improvement of immunity.	Mudgil and Barak, 2019 [2]
Plant based	B-Glucan, isoflavones, lauric acid, alpha-tocopherol, Phytosterols, especially β -sitosterol and γ -oryzanol, Phenolic compounds.	Protective effect against cancer, Cardiovascular disease, and Osteoporosis, Cholesterol lowering properties	Anurag <i>et al.</i> , 2016 [25]
Cereal based	phenolic compounds, dietary fibers, carotenoids, tocopherols, phytosterols, γ -oryzanol, and phytic acid	Antiapoptosis, Antiaging, Anticarcinogenic	Fang <i>et al.</i> , 2020 [5]

Fruit and vegetable based	Triterpenoids, hydroxytyrosol, punicalagin, catechin, sulforaphane, hesperdin, allcin, cynarine, b-carotene, lycopene	Aid in digestion, High antioxidant properties, Anti-inflammatory properties, and Combating several diseases.	Hernandez <i>et al.</i> , 2021 ^[34]
Tea and coffee	Polyphenols, catechins, theaflavins, flavonoids, caffeine, polysaccharides, chlorogenic acid, trigonelline, mangiferin etc.	Care neurological disorders, Prevent different types of cancer, Metabolic syndromes, Cardiovascular diseases, Urinary stone, Obesity, Type 2 diabetes	Banik <i>et al.</i> , 2021 ^[33]

Pharmacological properties

Functional beverages consumption plays an important role in human health, considering that metabolites, with a wide range of pharmacological effects, are inserted in the human diet. pharmacological effects, such as yerba mate, hibiscus, chamomile, lemongrass, fennel and mentha (Finzer *et al.*, 2018) ^[14]. The beverage, with considerable use in South America, is yerba mate, which has recently gained attention in others parts of the world due to its pharmacologic and nutraceutical effects. Coffee is among the most widely consumed pharmacologically active beverage, and its consumption has become a regular part of daily life worldwide. Coffee consumption has been associated with higher concentrations of serum total cholesterol and low density lipoprotein cholesterol (LDL-C). Cafestol and kahwoel are two diterpenes found in coffee, and are the main cholesterol-raising compounds in coffee, but they are mostly removed by paper filters. The consumption of camellia tea infusions has been linked to low incidence of chronic pathologies. Furthermore, numerous enzymes have been considered as a target for inhibition by *C. sinensis* polyphenols or tea. Yerba mate is a health promoting botanical source which contains in its composition scaffolds that can exercise different roles in animal metabolism. The passiflora tea were evaluated for total phenolics (TPs), total flavonoids (TFs), condensed tannins (CTs), and antioxidant activity (DPPH and FRAP). Free-choice Profile and acceptance, compared with green tea, were performed for sensory characterization (Melo *et al.*, 2014). Mediterranean medicinal and aromatic herbs contain a wide range of bioactives (nonvolatile polyphenols, volatile terpenes) that are important constituents of herbal extracts and essential oils. The antioxidant capacity and potential health benefits of these bioactives could be associated with their synergistic effects.

Medicinal properties

Functional beverages include nutrients and bioactive compounds used for improving the health performance. Functional beverages are excellent source of functional compound including vitamins, minerals, polyphenols, amino acids and bioactive compound and their mechanisms of action included antioxidant effect. Depending on their content and production methods, the functional beverages reduce cancer risk, boost immune system, improve physical and mental conditions, and show anti stress, antiaging, antioxidant and anti-inflammatory properties. The dairy based functional beverage include milk fortified with probiotics, prebiotics, phytosterols, antioxidant bioactive peptides from milk, dietary fiber, minerals, vitamins, and colostral immunoglobulin's. Which helps exert cytotoxic effects upon intestinal cells (Caco-2), protect intestinal epitel damage, and reduce the development of atherosclerosis and neurodegenerative disorders such as Alzheimer and Parkinson 's disease and multiple sclerosis (Tolun and Altintas, 2019) ^[9]. Due to their inherent antioxidant properties functional teas have the potential to grow as profitable functional beverages, as they can offer the health benefits for the digestive promotion,

protection against colds, and strengthening of immunity etc (Maqsood *et al.*, 2019) ^[22]. Caffeine suppresses fat absorption, while neochlorogenicm acid and feruloylquinic acid mixtures suppress visceral fat accumulation and body weight gain by increasing hepatic carnitine palmitoyltransferase. Functional fruit based beverage have ellagic acid and Lactobacillus plantarum DW12 therefore it reduces Antistress, suppress the propagation of cancer cells, antihypertensive, antidiabetes, antimicrobial, antioxidant, reduce risk of Alzheimer's disease, Cardioprotective, anti-atherogenic, antihypertensive, antidepressant and neuroprotective (Les *et al.*, 2017) ^[21].

Applications

Food applications

A functional beverage is a conventional liquid food marketed to highlight specific product ingredients or supposed health benefit. It includes conventional foods, modified foods, medical foods, and foods for special dietary use. In food application the Functional beverages include dairy beverages, sports and performance drinks, energy drinks, ready-to-drink teas, "smart" drinks, fortified fruit drinks, plant milks, and enhanced water. The main function of sports drinks is to keep athletes hydrated while restoring the electrolytes, carbohydrates and other nutrients, which can be depleted from exercising and the fortified sports drink market topped nearly \$18 billion in 2008 according to Euro monitor. An energy drink is a type of beverage containing stimulant drugs, chiefly caffeine, which is marketed as providing mental and physical stimulation. They may or may not be carbonated and many also contain sugar or other sweeteners, herbal extracts and amino acids. There are many brands and varieties of energy drinks. Based on the numbers reported by Euro monitor, the fortified energy beverage category has more than doubled over the past years, topping out at \$14 billion in 2009. Teas Black, Green, Oolong tea are beneficial for health and wellness, the 'natural' platform offered by tea, accompanied by its already perceived health status due to its polyphenol content, is a major attraction for consumers. RTD teas are a convenient and desirable vehicle for fortification that can add even more health benefits to the drinks. Green tea enriched with broccoli by-products concentrate (Viguera *et al.*, 2011) ^[11]. The market for fortification within this product category is wide open and offers opportunities for manufacturers to develop and introduce products that one might term Super Tea. Currently being introduced into the marketplace are RTD teas that incorporate super fruit extracts such as pomegranate and mango. Dairy Based Milk has often been called "nature's perfect food" and dairy based beverages such as drinkable yogurts, continue to be a staple of a healthy diet in many parts of the world. Dairy based yogurt beverages can be developed with omega 3 and hydrolyzed collagen ingredients which can be part of a healthy diet. Universal in its appeal, juices are perceived as healthy and as a good source of fortification and a great opportunity to add additional functional ingredients that can greatly enhance the appeal to consumers and the worldwide fortified fruit/vegetable juice market topped out at just over \$10 billion in 2014. Soy beverage is a good source

of soy protein and is low in saturated fat, cholesterol, and added sugar and Soy milk is available in many supermarkets and specialty store. The term enhanced water is generally used to refer to any type of bottled water that has added ingredients to improve its taste and/or offer additional nutritional benefits. Enhanced waters are sometimes called fortified water or herbal water also its any type of water that adds a functional benefit above and beyond hydration. Most enhanced waters are lower in calories per ounce than non-diet soft drinks. The marketing of enhanced water usually capitalizes on the healthful image of water combined with the perceived health, taste or functional benefits of one or more additional ingredients. In use of apple peel Tomato and carrot juices enriched with its flavonoids extract (Ryan *et al.*, 2016) [26]. Model beverage based on cloudy apple juice fortified with hydrolysed carrot pomace (Routray and Orsat, 2019) [6].

Industrial application

Functional beverages are an innovative sector in the beverage industry because they give consumers many health benefits that they can choose according to their own needs. It is a subsector of the functional food and non-alcoholic beverage industry and it is the fastest growing sector. This rapid growth is partially due to the combination of maturity of the carbonated soft drink sector and heavy investments by major food and beverage companies. In 2006, the functional beverage per capita consumption has risen to 66.4 gallons, while the carbonated soft drink sector has a decline in their per capita consumption to 50.4 gallons. The functional beverage industry encompasses a wide range of varieties targeting different health related concerns. One trend for functional and sensory benefits such as thirst quenching ability with daily dosage of vitamins or other nutrients. Another one is probiotics, exemplified by Activia yogurt, for gut health and boosting natural defences or immune system. Memory and mental sharpness has also been a focus, with Function BRAINIAC, a Carrabolla punch Energy Drink in the Function Drinks line. Children's functional drinks received attention with leading brand Nestlé's Boost. Weight loss, health and beauty drinks, also lastly, energy-boosting functional beverage products, such as Red Bull and 5-Hour Energy, have been well-known in the functional beverage market. Fortified segment of the industry has opportunity for

the future functional beverages based on milk or dairy ingredient. Industrial applications in production of whey beverages are known to exist, utilising either the immobilised enzyme route or by using soluble enzymes (Jelen, 2009) [18]. The extract protein from industrial HM, and further application of the obtained protein in a functional beverage (Sen and Kahveci, 2020) [27].

Health effects

A functional beverage is a non-alcoholic drink which benefits specific bodily functions in addition to providing general nutritional benefits. Whole, fortified, or enriched foods have a potentially beneficial effect on human health when consumed as part of a varied diet on a regular basis. It can be beneficial in providing targeted health benefits to keep your body active and help in enhancing concentration and improving memory. Functional beverages have beneficial effects on one or more functions of human body in addition to their basic nutritional values. Thus, they either improve the general physical conditions of human body or decrease the risk of disease progression (Doble *et al.*, 2019) [7]. Functional beverage can eliminate health risk behaviours such as poor diet, inactivity, and smoking would prevent 80% of heart diseases and stroke, 80% of type-2 diabetes, and 40% of cancer (Spring *et al.*, 2012) [32]. Nutraceutical Drinks are widely manufactured for some specific health benefits such as maintaining heart, brain, and other crucial organ's health, immunity, beauty, and many more. Fruit based functional beverages have bioactive compounds to improve the blood lipid profile, reduced oxidative stress, prevent atherogenic modification of LDL cholesterol and improve HDL cholesterol concentration (Tolun and Altintas, 2019) [9]. Functional water and probiotic drink can help healthy skin, hair, bones and joints digestive health, Immunity, Protein utilization (Tutar *et al.*, 2019) [8]. Probiotic tea can help improvement of digestive system. Functional beverages in sport considering both athletes' health and sports performance. Sports drinks are containing omega-3 fatty acids and CoQ10 for heart health, fiber and probiotics for both gut health and weight management, collagen for improving overall skin appearance and vitamin D, and zinc for enhanced immunity. Due to euro monitor notes that as many as 75% of consumers now say they are interested in functional products that support immune health.

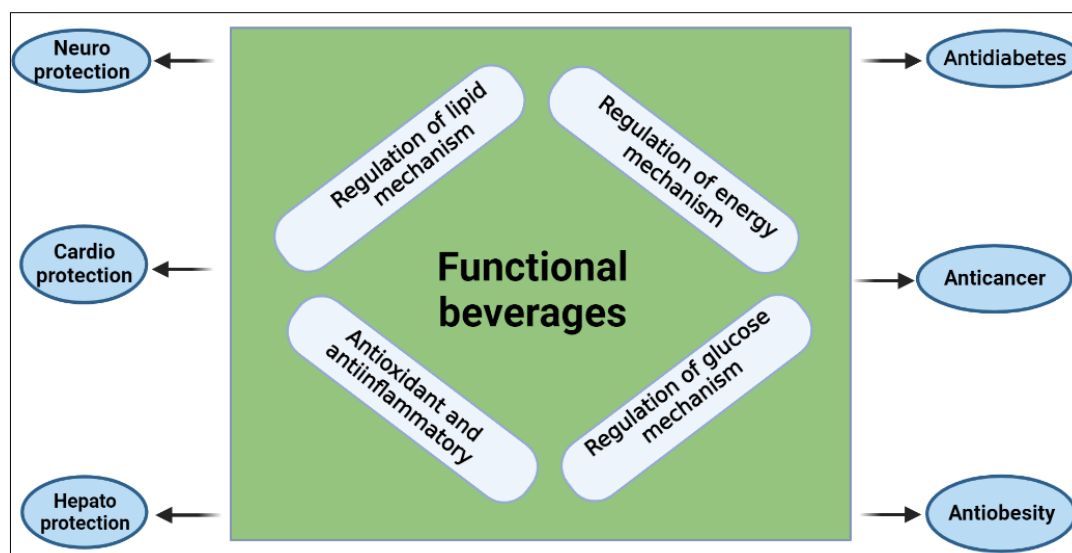


Fig 2: Health-promoting effects of functional beverages

Conclusion

Although no concrete definition of “functional food” or “functional beverage” is agreed upon worldwide, there is a consensus about the word “functional” in that functional foods and beverages are used to enhance certain physiological functions in order to prevent or even to cure diseases. Increased attention to consumer’s health has given a strong input to advance food market. Functional and medicinal beverages are an opportunity for the industry economy, and for the consumer health. The formulation and development of functional beverages has gained immense attention in the recent years due to their significant contribution to health promotion and disease risk reduction. The functional beverages have been considered as ideal vehicles for the delivery of potential bioactive components such as “probiotics” which are live microorganisms which help in maintaining good health through good intestine. To increase the chance of a new product in the market with high success, the scientific evidence, daily intake limit, consumer acceptance, legal regulations, and commercial aspect must be considered altogether. Further, beverage manufacturers may improve and differentiate functional beverages using research outcomes.

Future and scope

Functional beverage sector has tremendous scope for growth because of their demand and consumer awareness towards health and food. Functional beverages, which beverages are commonly consumed worldwide and constitute the fast growing segment of the functional food sector, are the impotent food sector which boosts a wide variety of products including dairy, non-dairy, fruit, and herbal-based beverages. Functional beverages market, stand for one of the biggest and rapidly growing food markets in upcoming years, several new functional beverages products will be available in market due to their popularity. The world market has proof of its huge demand for healthy beverages over the last years. Market trends indicates that milk-based functional beverages are ideal vehicles for the bioactive food ingredients targeting lifestyle disease (Mudgil and Barak, 2019)^[2]. Cereal grain-based milk, a recent emergent on the market, is a functional beverage with increases global popularity because Compared to cow’s milk, cereal milk is lactose-free, hypoallergenic and contains bioactive components with health-promoting properties as well as being economical and sustainable (Fang *et al.*,2020)^[5]. The future beverages will be sugar-reduced/sugar-free and naturally formulated ones which improve mood and boost brain health and with plant proteins in line with global trend (Tireki, 2021)^[30]. Plant-based milk alternatives represent an enormous expansion prospective for health food market and its popularity increase more (Anurag *et al.*, 2016)^[25]. The future of functional beverages depends on their sensory properties, shelf life, stability and physiological benefits that are rendered by them (Mudgil, 2018)^[2]. Now in japan the scope of functional foods is larger than Food for Specified Health uses (FOSHU) and even larger than Food with Health Claims (FHC) (Miroso *et al.*, 2020)^[16]. The functional beverages market is highly fragmented with the presence of many small- and medium-sized enterprises. Players are striving to gain competitive edge by developing functional beverages with varied nutritional value. Hence, significant players in the market are investing heavily in R&D, and mergers & acquisitions. Due to the increase in consumption of

healthy and nutritious drinks, there has been emergence of products such as functional tea, functional juice functional soda and also functional sparkling water. The functional beverages market is planted to record a CAGR of 6% from 2022 to 2032.

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