

Functional Fruit Juices

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Lately, consumers are increasingly concerned about their dieting, hence expect to eat foods that will improve their well-being and health: This can be achieved by eating foods with added functional components. Fast-paced modern lifestyle reduces time to consume fresh fruits and vegetables, so people prefer to consume juices, and that caused demand for functional fruit juices to grow rapidly. Accordingly, the recent trends in juice and beverage industry are oriented towards production of functional juices and drinks with various raw materials, such as vitamins and their precursors, minerals, biologically active compounds (BACs; e.g. polyphenols, carotenoids, chlorophylls, tannins, etc.), antioxidants, probiotics and prebiotics. Due to respectable nutritive value, fruit juices were found to be an excellent carriers or delivery vehicles of probiotic bacteria. Juices produced from "superfruits" can be considered excellent functional matrices, because they contain a high proportion of various types of BACs. Further, fruit juices with added probiotics (e.g. lactic acid bacteria *Bifidobacterium* and *Lactobacillus*) and prebiotics (e.g. lactulose, inulin, *fructooligosaccharides*, etc.) are becoming popular beverages among consumers.

functional fruit juice

probiotic

antioxidant

beverage

1. Introduction

In recent years, consumers have become increasingly interested in "healthier" alternatives of their favorite food products, so the food industry has focused on manufacturing more nutritionally valuable alternatives that will meet new higher standards from the markets. One way to achieve this is to create completely new products or to add some functional compounds to existing products. Functional foods are industrially processed or unprocessed natural foods that have positive health effects, beyond its basic nutritional value, if consumed regularly [1]. For this reason, functional food is an increasingly popular term in social and scientific area, thus food industry continues to invest in the development of food sector that can provide products with additional benefits to consumers' health. Here is important to stress that for the foods to be labeled as "functional," clinical trials (i.e. randomized, double-blind, and placebo-controlled) should be employed to draw conclusions about the health benefits of the products [2].

Fruits and vegetables are an integral part of a normal dieting and are significant sources of nutrients such as vitamins, minerals and dietary fibers. To meet daily needs, the World Health Organization (WHO) recommended consumption of a minimum of 400 g of fruits and vegetables per day, while in some countries, such as Sweden and Finland, this recommended boundary is up to 500 g per day [3]. This is not surprising, as the most common dietary deficiencies are related to insufficient consumption of fruits and vegetables [4]. Several studies stated that consumption of at least five servings a day of fruits and vegetables reduces the chances for mortality from

myocardial infarction by 15%. Furthermore, daily consumption of 600 g of fruits and vegetables can reduce the incidence of coronary heart disease by 31% and ischemic stroke by 19% [5] with reduction of a stress and fatigue [6].

Due to the fast lifestyle, consumers sometimes lack sufficient time to eat fresh fruits and instead consume fruit juices. The European Fruit Juice Association (AIJN) announced in a report for 2017 that in the last 5 years the production of fruit juices (not produced from concentrates) has reached a growth of 5.4%, as well as the production of freshly squeezed juices of 4.8%. On the other hand, production of nectars and other beverages with added sugars and other additives decreased by 3.8% and 1.6%, respectively.

2. Component

New products in the fruit sector of the food industries are mainly designed as consumers are willing to pay a higher price to get a nutritionally enhanced product, and they prefer to consume perceived healthier foods (e.g. organic) rather than conventional ones [7]. Functional fruit juices can be designed by adding some functional components to usual fruit juices (e.g. carotenoids, phenolic acids, flavonoids, fatty acids, probiotics, prebiotics, minerals, and vitamins). For instance, originally fruit juices with high vitamin C content, such as citrus juices, were considered as functional, due to the fact that vitamin C is an important antioxidant [8].

Antioxidants found their first application in food industries as additives to the oils and fats for prevention of the oxidative spoilage [9]. They were later found as effective in slowing down oxidative reactions and preventing oxidative stress. Therefore, antioxidants have been increasingly used as both, food additives and supplements [10]. Various groups of biologically active compounds, such as phenolic compounds (e.g. flavonoids, phenolic acids, stilbenoids, coumarins, lignins and tannins), carotenoids (e.g. carotenes and xanthophylls), terpenoids (e.g. monoterpenes, triterpenes and some sesquiterpenes) are also considered as antioxidants.

Some fruit juices, such as those produced from “superfruits” can be considered as excellent matrix for functional beverages, because of their natural chemical composition, particularly referred to the high contents of different BACs, and their corresponding antioxidant activities [11]. “Superfruits” category includes wild fruit species such as blueberries, goji berries, acerola, acai, camu-camu and others. Bioactive potential of functional fruit juices might be improved by mixing different types of juices (e.g. cranberry juice and pear juice) in various ratios [12].

Due to the increasing lactose intolerance, allergies, reduction in fat and cholesterol intake and growing vegetarianism, the feasibility of incorporating probiotic bacteria to non-dairy matrices, such as fruit juices, have been widely explored. In this regard, fruit juices have been reported as suitable carriers for the delivery of probiotic bacteria, as they are rich in polyphenols, vitamins, minerals and other nutritive compounds [13].

It was found that the use of probiotics positively affected the nutritional properties of the food products, particularly in fruit juices where the addition of probiotics improves their nutritive values and stabilizes the product (limited to a certain strains of lactic acid bacteria) [14]. The most frequently used microorganisms as probiotic cultures in fruit

beverages are the different strains of *Lactobacillus plantarum*, *Lactobacillus acidophilus*, *Lactobacillus helveticus*, *Lactobacillus casei*, *Lactobacillus paracasei*, *Lactobacillus rhamnosus*, *Lactobacillus reuteri*, *Bifidobacterium breve*, *Lactobacillus gasseri*, *Lactobacillus crispatus*, and some others [15]. In order to achieve desirable sensory and nutritive characteristics of functional fruit juices, proper strain selection and differentiation is of a great importance. As that is important for ensuring their stability, survival, and functionality. Additional to the selection of the appropriate fermentation conditions that are crucial parameters in order to avoid lethal or sub-lethal damages to the probiotic cells during the processing and subsequent storage [16]. Moreover, recent research confirmed polyphenols as prebiotics capable of modulating intestinal microbes that further affected markers mostly associated with cardio-vascular diseases [17].

In conclusion, functional probiotic fruit juices are rich in polyphenols and may offer improved delivery of nutritional and functional properties of a food product. They are capable of supplying positive health benefits from various sources, e.g. polyphenols and probiotics.

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