



Fruit-Fortified Yogurt: Enhancing Nutritional and Health Benefits: A Review

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ABSTRACT

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A popular dairy product, yogurt is well-known for its high probiotic content and health advantages. Enhancing its nutritional profile with fruits has gained significant attention due to the increasing consumer demand for functional and health-promoting foods. Fruits serve as natural sources of vitamins, minerals, dietary fiber, antioxidants, and bioactive compounds that can enhance the overall nutritional quality of yogurt. This review explores the impact of fruit fortification on the physicochemical, sensory, and probiotic properties of yogurt. It discusses the selection of fruits and their influence on yogurt flavor and sensory properties. Additionally, the potential health benefits, including improved antioxidant activity, gut health, and immune support, are highlighted. The findings suggest that fruit-enriched yogurt offers a promising strategy for developing functional dairy products with enhanced nutritional and sensory attributes.

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Introduction

Yoghurt is classified as fermented milks and could contain a maximum of 50% (m/m) of non-dairy ingredients (such as vegetables and fruits as well as purees, juices, pulps) and its commonly used starter cultures are *Streptococcus salivarius* ssp According to Codex Standard (243-2003). Yogurt is a popular cultured dairy product that has been utilized across various cultures for centuries, attributed to its sensory qualities, uniform texture, and numerous health benefits. It is regarded as a nutritious food because of the advantageous effects of its live bacteria, which enhance lactose digestion in individuals who are lactose intolerant and possess the capacity to inhibit pathogenic organisms. Furthermore, yogurt's fermentation process can elevate the bioavailability of specific nutrients and liberate bioactive compounds that exhibit antioxidant and anticancer characteristics. Additionally, the intake of yogurt has been linked to anti-inflammatory effects and a reduction in the prevalence of metabolic syndrome (Pereira et al., 2013).

To increase the nutritional appeal, several functional ingredients can be added to yogurt. Egg, protein hydrolysates, prebiotics, calcium salts, and a probiotic have been added to the commercial plain Greek yogurt also known as strained yogurt. Furthermore, commercial

flavored yogurts are often supplemented with pieces of different fruits, so as to increase the energy value, shelf life, and palatability, and to provide a good source of dietary fiber or micronutrients (Pannerchelvan et al., 2024).

Nowadays consumer awareness regarding health benefits of adding fruits to yogurt, who perceives yogurts containing so-called super fruits as better choices. Concomitant with these actions, the consumption of functional yogurts with pieces of fruit in conventional and low-fat versions has increased significantly. Therefore, fruit consumption can be enhanced through the preparation of yogurts with a stabilized form of fruit, which gives them a very good sensory acceptance. Fruit pieces are added to yogurt in an effort to boost its antioxidant activity and usefulness (Mendoza Mencia & Janny Melissa, 2018). In a recent review, thirteen yogurts with bits of different fruits have had their antioxidant potential compared. The most interesting yogurts were those containing pieces of blueberry, raspberry, blackberry, strawberry, red berries, cherry, pineapple, kiwi, mango, pomegranate, and grapes. Fruits are a source of several phytochemicals considered as natural antioxidants such as vitamin C, vitamin E, phenolic compounds and carotenoids (Dhalaria et al., 2020).

The recent statements by European agencies on the benefits of yogurt have boosted the dairy industry, which includes yogurt, together with research in recent years. Although, dairy product consumption has been linked to a lower chance of contracting illnesses including cardiovascular disease (CVD), it has been documented for yogurt that its stimulation of the itch has positive impacts on wellbeing and health (Glanville et al., 2015). Since its creation several centuries ago, yogurt a fermented dairy product has become popular all over the world, where it is consumed fresh or combined with other ingredients such as fruit. Yogurt's nutritional and practical qualities are influenced by manufacturing conditions and the bacterial species used for fermentation. Approximately 70% of the yogurt is made up of water, has proteins of high biological value (2.5–5.6%), with most indispensable amino acids, useful in the growth and repair of tissues. The low lactose content is due to the fermentation process, and its consumption by intolerant people is better tolerated compared to unfermented milk. Lactic acid bacteria (*Lactobacillus bulgaricus* and *Streptococcus thermophilus*) are essential yogurt production. However, incorporating other microbial species can enhance yogurt with additional health benefits (Pereira et al., 2013).

Types of Yogurt

Yogurt comes in various types, each with unique characteristics and production methods. Traditional yogurt is produced by fermenting milk using lactic acid bacteria, primarily *Lactobacillus bulgaricus* subsp. *bulgaricus* and *Streptococcus thermophilus* (Nagaoka, 2019). Lactic acid is produced by these bacteria, which decreases pH and causes milk protein coagulation, resulting in the characteristic texture and flavor of yogurt.

The market offers various types of functional yogurts Table1, such as lactose-free, high-protein, probiotic, prebiotic, synbiotic, and easily digested yogurt (Saritaş et al., 2024). Greek yogurt, also known as strained yogurt, is a concentrated form obtained by draining whey, resulting in higher total solids and lower lactose content compared to regular yogurt (Gyawali et al., 2022). Additionally,

phytosterol-enriched yogurt has been developed as an innovative functional food (Izadi et al., 2015).

However, the yogurt industry has evolved to offer a wide range of products catering to various consumer preferences and health needs. From traditional yogurt to specialized functional varieties, the market continues to expand with innovative formulations and production techniques. The diversity in yogurt types reflects the growing interest in healthy consumption and the versatility of yogurt as a vehicle for delivering bioactive compounds and nutritional benefits to consumers (Bankole et al., 2023; Saritaş et al., 2024).

Nutritional Benefits of Yogurt

Yogurt is widely recognized as a functional food with numerous health benefits showed in Table 2. It is rich in essential nutrients, including protein, calcium, and probiotics, which contribute to its positive effects on human health (Fisberg & Machado, 2015; Munteanu-Ichim et al., 2024). Yogurt consumption on a regular basis has been linked to better digestive health, enhanced immune function, and reduced risks of various chronic diseases such as type 2 diabetes, metabolic syndrome, and heart disease (Kok & Hutkins, 2018).

Yogurt's benefits extend beyond basic nutrition. It has been shown to alleviate symptoms of lactose intolerance, constipation, and diarrheal diseases (Shiby & Mishra, 2013). Moreover, yogurt consumption may have positive effects on weight management, cholesterol levels, and blood sugar regulation (Pei, 2015). Some research even points to possible advantages for cognitive performance and mental health (Pannerchelvan et al., 2024).

Additionally, yogurt's versatility as a functional food is evident in its wide-ranging health benefits. From improving gut health and boosting immunity to potentially aiding in obesity management and mental health, yogurt offers a multitude of advantages (Kok & Hutkins, 2018; Pannerchelvan et al., 2024; Pei, 2015). To completely validate some of these claims and maximize the health advantages of yogurt consumption, more study is necessary, especially randomized-controlled studies, even though the evidence is encouraging (Pei, 2015).

Table 1. Some of Yogurt Types.

Yogurt name	Properties	Reference
Plain Yogurt	Composed of dairy products and can be either vat or cup fermented.	Chandan & Kilara, 2013
Greek Yogurt also known as (strained yogurt)	Compared to unstrained yogurt, labneh, or strained yogurt, has a thicker consistency.	Kilara & Chandan, 2013
Frozen Yogurt	90% ice milk mix and 10% plain yogurt are combined to make frozen yogurt.	Chandan & Kilara, 2013
Flavored Yogurt	Fruit preparations and flavorings are made based on the type of yogurt.	Chandan & Kilara, 2013; O'Rell & Chandan, 2013a,b
Drinkable Yogurt (Yogurt Beverages)	Salted with certain spices, or sugar-sweetened, in order to prolong the shelf life. Yogurt-based beverages made from oats have been created with the same sensory characteristics as yogurt-based beverages.	Aneja et al., 2002; Luana et al., 2014
Ayran (yoghurt drink)	Special kind of acidic milk drink, and it is popular in Asia and the Middle East countries.	Erkaya et al., 2015

Table 2. Nutrition Benefits of Yogurt

Benefits	Reference
Bone health	Bridge et al., 2020; Shevroja et al., 2021; David et al., 2022
Gut health	Patro-Golab et al., 2015; Fox et al., 2015; Liu et al., 2015; Mirghafourvand et al., 2016; Mohammadi et al., 2021
Cardiovascular diseases	Cormier et al., 2016; Farvid et al., 2017; Ziaei et al., 2021
Diabetes	Ejtahed et al., 2012; Asemi et al., 2013; Li & Xing, 2016
Supports immune function	Stefka et al., 2014; Song et al., 2016; Pu et al., 2017
Weight management and satiety	Astrup, 2014; Jacques & Wang, 2014; Kelishadi et al., 2014
Source of vitamins and minerals	Chandan & Shah, 2013; Pan et al., 2016
Gastrointestinal benefits	Prentice, 2014; Savaiano, 2014; Mohammadmoradi et al., 2014; Morelli, 2014; Chandan, 2016
Decrease in blood cholesterol and cardiometabolic disorders	Astrup, 2014; Beserra et al., 2015; Beltran-Barrientos et al., 2016
Control of infections	Beerepoot et al., 2012; King et al., 2014; Barker et al., 2015
Anti-carcinogenesis	De Leblanc, 2014; Elfahri et al., 2016
Skin health	Kimoto-Nira et al., 2014; Hill et al., 2014

Nutritional Benefits of Fruits

Fruits are popularly known for their significant nutritional benefits and health-promoting properties. They are excellent sources of essential nutrients, including dietary fiber, vitamins (particularly folic acid, pyridoxine, niacin, thiamine, and vitamin C), minerals, and phytochemicals such as antioxidants and carotenoids (Alemu, 2024). These components play crucial roles in human nutrition and health, contributing to the preventing a number of chronic

diseases and promoting overall well-being.

Interestingly, not only the edible parts of fruits but also their by-products, such as seeds and peels, have been found to possess functional properties and nutritional value. Fruit seeds, for example, include bioactive components that can be used for both dietary and medicinal purposes, such as proteins, vitamins, flavonoids, and carotenoids (Kumar et al., 2024). Additionally, berry fruits are particularly noteworthy for their high nutritional content and remedial effects on several diseases, attributed to their rich phenolic compounds (Vahapoglu et al., 2021).

Therefore, the consumption of fruits, including whole fruits, fruit juices, and even fruit-derived products like fruit bars, can provide numerous health benefits. These include decreased cancer risk and better cardiovascular health, enhanced gastrointestinal health, and better weight management (Dreher, 2018; Keck & Orrego et al., 2014). The nutritional value of fruits extends beyond basic nutrition, offering substantial health benefits through their nonnutritive components and bioactive substances (Cosme et al., 2022; Keck & Finley, 2004). As such, increasing fruit intake is highly recommended as a component of a healthy diet to promote overall health and prevent various chronic diseases (Tafari & Latino, 2025; Clemens et al., 2016).

Yogurt Combining with Fruits

Consuming yogurt has been linked to improved metabolic profiles, healthier eating habits, and higher-quality diets. Regular yogurt eaters ingest more nutrients and improved diet quality, including greater intake of dairy, complete grains, fruits and vegetables as opposed to

low or non-consumers (Panahi & Tremblay, 2016). This suggests that combining yogurt with fruits can be particularly beneficial for overall health.

Interestingly, recent studies have shown that consuming yogurt and certain fruits may have protective impacts against specific health conditions. For instance, Yogurt and dried fruits were found to have a protective effect against idiopathic pulmonary fibrosis (IPF) in a Mendelian randomization trial (Zhang et al., 2024). Additionally, berry fruits, which are rich in vitamins, minerals, and phenolic compounds, have been found to have remedial impacts on several diseases and positively impact various body systems, including gastrointestinal, cardiovascular, immune, and nervous systems (Vahapoglu et al., 2021).

So that, combining yogurt with fruits, especially berries and dried fruits, can provide a synergistic effect on health. Yogurt's probiotic content and nutritional profile, coupled with the high nutrient and phytochemical content of fruits, make this combination a valuable addition to a healthy diet. But it's crucial to remember that a number of pre- and post-harvest factors might have an impact on the nutritional value of fruits (Alvarez-Suarez et al., 2014), highlighting the need for proper handling and storage of both yogurt and fruits to maximize their health benefits.

Nutrition Benefits of Fruit Yogurt

When fruits are added to yogurt, they boost the overall nutrient content, providing a broader spectrum of vitamins and minerals that support various bodily functions as showed in Table 3.

Effect of Fruits on Nutrients and Sensory Properties of Yogurt

Yogurt enrichment with fruits has gained attention for enhancing its nutritional and sensory properties. Various studies demonstrate that incorporating fruits not only boosts antioxidant activity and phenolic content but also improves the overall acceptability of yogurt products. The following sections outline the key findings regarding fruit-enriched yogurt Table 4.

Table 3. Previous Studies Observed Nutrition Benefits of Fruit Yogurt

Nutrition benefits	Type of fruit	Function	Reference
Vitamins and antioxidants	Berries (blueberries, strawberries, raspberries)	Lower the risk of heart disease and several cancers	Basu et al., 2010
Minerals (Cardiovascular health)	Bananas	Help maintain blood pressure regulation, support muscle function and while yogurt's calcium content supports cardiovascular health.	Padayachee et al., 2017; Slavin & Lloyd, 2012
Probiotic and fiber synergy	Fiber-rich fruits like apples, berries, or pears	improve digestion , reduce the incidence of constipation, promotes a healthy gut microbiome and aids digestion	Slavin, 2013
	Apples	Satiety and weight management (promote satiety and reduce overall calorie intake)	Hess et al., 2014; Wang et al., 2014; Mozaffarian et al., 2011
Support for heart health	A lot of Fruits are source of antioxidants and prebiotic fibers and polyphenols	Decreased risk of heart disease and blood pressure.	Fernandez & Murette, 2017
Improved immune function	Passion fruits	Enhancement of immune function, and when paired with probiotics it offers a more robust defense against infections, formulate stirred fruit yogurt enhancement of immune function which has a probiotic effect.	Jeyasekaran & Deepa, 2021
Blood sugar regulation	Monk fruit	lower the risk of type 2 diabetes	Ban et al., 2020
Bone and muscle health	Some fruits are fortified with vitamin D (like fortified orange juice)	Dairy products like yogurt in supporting bone health, particularly when combined with vitamin D-rich fruits.	Biancuzzo et al., 2010

Table 4. Nutritional and Sensory Impacts of Various Fruit Additions to Yogurt

Fruit addition	Nutritional impact	Sensory impact	Reference
Papaya puree	Increased protein by 46% reduced fat by 27%	Preferred at 20% addition	Othman et al., 2019
Persimmon and apple	Boosted fiber and minerals	Acceptable sensory characteristics	Karaca et al., 2019
Mango and papaya	Enhanced antioxidants activity	Mango powder most acceptable	Cao et al., 2025
Pineapple and roselle	Higher antioxidant content	4% pineapple most preferred	Bakar et al., 2024
Strawberry varieties	Higher phenolic content and antioxidant activity	Albion variety most favored	Ünal, 2025
Persimmon (diospyros kaki) powder	Contains approximately 16% carbohydrates, contains pectin and mucilages from soluble fibers, vitamins A, C and potassium	Acceptable sensory attributes	Kanca et al., 2024
Red dragon fruit Peel	Improved quality attributes and sensory properties	2% addition most acceptable	Yeasmin et al., 2023
Passion fruit	Increased protein and reduced fat	Improved sensory attributes	Mbaeyi-Nwaoha & Ezeoke, 2019
Tumbo fruit pulp	High antioxidant capacity	High acceptability scores	Inocente-Camones et al., 2022
Pomegranate juice	High antioxidant	Improved sensory attributes	Al-Aswad et al., 2018

Conclusion and future aspects

Among the category of dairy products, yogurt is recognized as a functional food, and due to it being the most appropriate matrix for bifidobacteria delivery, the combination of bifidobacteria and yogurt is expanding. Moreover, yogurt's nutritional status improves significantly due to the incorporation of fruits, which is also consistent with the market trend for healthy and ready-to-eat foods. Furthermore, it is crucial to investigate the potential of fruit in yogurt as it is implemented with the aims of increasing its antioxidant potency and functionality.

Declarations

Conflict of Interest

The authors declare no conflict of interest

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