**Nutritional Composition and Health Benefits of Superfoods: Potential Roles in Chronic Disease Prevention and Dietary Applications**

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**Abstract**

Recent advancements in the fields of food science and nutrition have led to the emergence of a distinct category of food products commonly referred to as “superfoods.” These foods are characterized by their ability to exert multiple health-promoting effects, including the prevention of various diseases, enhancement of immune function, and provision of essential macro- and micronutrients in substantial amounts. The growing consumer awareness regarding health and wellness has contributed to the increasing popularity of superfoods in the global market. Despite the longstanding traditional use of many of these foods for their perceived health and therapeutic benefits, the scientific basis and mechanisms underlying the concept of superfoods remain relatively underexplored. This category typically includes a wide range of fruits, vegetables, whole grains, and other plant-based products known for their dense nutritional profiles and bioactive constituents.The present review focuses on the nutritional composition of selected superfoods and explores their potential roles in mitigating the risk of chronic diseases. The findings may assist consumers in making informed dietary choices and incorporating superfoods more effectively into daily nutritional practices to support overall health and disease prevention.

Key words-Bioactive, Health Promototing, Plant-based, Superfood, Therapeutic

**Introduction**

In recent years, growing scientific evidence has highlighted the significant impact of food and its individual components on human health, leading to a substantial shift in consumer attitudes toward dietary choices. Beyond fulfilling basic physiological needs such as hunger and nutrient supply, an increasing proportion of consumers now regard food as a means to promote overall health, prevent nutrition-related disorders, and support both mental and physical well-being.This concept, rooted in historical perspectives—most notably in the Hippocratic maxim, “Let food be thy medicine and medicine be thy food”—has gained renewed relevance. Foods that contribute to improved physiological function, aid in the prevention of various diseases, and may even be employed in therapeutic contexts are commonly referred to as "functional foods." The term “functional food” was first introduced in Japan approximately three decades ago and has since gained global recognition and acceptance across scientific, regulatory, and commercial sectors.In addition to their potential to lower healthcare costs associated with aging populations, functional foods hold significant commercial value within the food industry. In contemporary usage, the term “superfoods” is frequently employed to describe a subset of functional foods recognized for their high nutritional density and associated health benefits (Siró *et al.,* 2008).In recent years, superfoods have garnered considerable interest, particularly among populations in Western countries. These foods are recognized for their high concentrations of essential macro- and micronutrients, contributing to their perceived health-promoting properties. According to the Oxford English Dictionary, a superfood is defined as a food item regarded as especially nutritious and beneficial to overall human health and well-being (Meyerding *et al.,* 2018).

The term "superfoods" initially emerged in reference to functional foods and is now widely used as a broad descriptor for foods that, beyond their conventional nutritional value, provide additional health benefits and may contribute to the prevention of various diseases (Lunn, 2006).Conversely, the term “superfoods” may also encompass certain traditional food products that have been enhanced through various processing techniques to improve their functional properties, without the need for genetic modification (Hefferon, 2012).While superfoods share similarities with functional foods in terms of providing health-promoting benefits beyond basic nutrition, they differ in several key aspects. Superfoods are typically defined as minimally processed, naturally occurring foods that have a long history of traditional use. They are often associated with limited culinary and medicinal applications, particularly in remote or indigenous communities. Consequently, their growing popularity is not only attributed to their exceptional and inherent health benefits but also to their perceived authenticity and cultural uniqueness, often linked to isolated or exotic regions (Tacer-Caba, 2019).Superfoods have also been proposed to occupy a dual classification as both dietary and medicinal plants, owing to their rich composition of synergistic bioactive compounds that contribute collectively to their health-promoting effects (Wolfe,2009).

The term “superfood” is increasingly prevalent in scientific literature and is often employed in academic contexts to describe foods that are not only nutritionally dense and energy-rich but also appealing in terms of sensory and health attributes (Rozin, 2005).The produce section of supermarkets often exemplifies the concept of superfoods, primarily referring to fruits and vegetables that are especially rich in phytochemicals. The underlying principle is that by highlighting certain foods with high concentrations of antioxidants, micronutrients, or other bioactive plant compounds, dietary intake of these beneficial substances can be promoted to enhance health outcomes (Lunn, 2006).A recent study reported that a Google search for the term "superfoods" typically returns approximately 57 results within the first 15 pages of search listings (van den Driessche *et al.,* 2018).However, the term "superfoods" is more frequently encountered in marketing materials, product packaging, and media coverage, as well as in the context of innovative and alternative food ingredients aimed at promoting consumer well-being, rather than in scientific literature (Weitkamp & Eidsvaag, 2014). As of August 2018, a database search revealed that the term “superfoods” returned 191 results, including research articles, book chapters, and review papers, while the term “superfruits” yielded 85 results within the ScienceDirect database. In contrast, the term “functional foods” generated significantly higher counts, with 210,226 results on Wiley and 382,852 results on ScienceDirect for the period between 1998 and 2017. These findings suggest that the academic usage and conceptual framework of the term “superfood” differ substantially from those associated with “functional food.” (Tacer-Caba, 2019). Superfoods, and more specifically superfruits, are often composed of exotic fruits that are not widely recognized globally. These foods are attributed with a variety of health benefits, which include potent antioxidant activity and a high content of bioactive compounds such as anthocyanins, flavonoids, and phenolic compounds. Additionally, superfruits are suggested to exert beneficial effects on chronic conditions such as cardiovascular diseases and diabetes mellitus, frequently through the modulation of clinical biomarkers including blood pressure, body mass index, waist circumference, fasting blood glucose levels, and plasma triacylglycerol concentrations (van den Driessche *et al.,* 2018).

**Brazil Nuts**

Brazil nuts are among the most commonly consumed tree nuts in South America and are derived from the Brazil nut tree (*Bertholletia excelsa*), a large species native to the Amazon rainforest. This tree thrives in well-drained, compact soils typically found along the Amazon River and is predominantly located in countries such as Brazil, Venezuela, Colombia, Ecuador, and Peru.The fruit of *Bertholletia excelsa* is generally round or pear-shaped, with a woody, thick outer shell approximately 0.5 cm in thickness and a diameter of about 6 cm. Each fruit contains between 12 and 24 angular, three-sided seeds (commonly referred to as nuts). These seeds are irregularly cylindrical in shape, light cream in color, and enclosed within a hard, woody capsule. The seed capsule itself resembles a large grapefruit in size and can weigh up to 2 kilograms (Yang,2009).

Brazil nuts hold significant economic value, particularly for local and indigenous communities in South America. Harvesting typically occurs during the rainy season, after which the nuts are transported to processing facilities. The processing sequence includes several key stages: initial sorting and grading, drying, shell removal, and size classification.

The first stage—manual or visual sorting—is critical for the removal of nuts that are mold-contaminated or discolored. Following this, the nuts are grouped based on size. After undergoing controlled drying and cooling, the final product is sealed using heat and vacuum packaging techniques to ensure quality preservation and extend shelf life (Pacheco, & Scussel,2009).

Brazil nut kernels are of significant interest in food science research due to their rich content of proteins, lipids, and minerals, particularly selenium, which exhibits strong antioxidant properties. As a result, the food industry has increasingly focused on extracting oil from these nuts using hydraulic pressing methods, although the by-products of this process are currently underutilized.

The global recognition of Brazil nuts stems from their high caloric density and substantial nutritional value, prompting numerous studies aimed at isolating and characterizing their key functional and nutritional components. Among these, the lipid fraction is of particular industrial interest due to its economic viability and high yield potential. Brazil nuts are regarded as promising candidates for future commercial applications, offering favorable cost-benefit ratios and significant potential for advancement in experimental research and product development (Santos *et al.,* 2012).

**Nutritional Composition of Brazil Nuts**

**Macro-Nutrients**

The macronutrient composition of Brazil nuts includes approximately 3.5% water, 66.4% total lipids, 14.3% protein, and 12.3% carbohydrates. In terms of fatty acid profile, Brazil nuts contain around 25% monounsaturated fatty acids (MUFAs), 21% polyunsaturated fatty acids (PUFAs), and 15% saturated fatty acids (SFAs). Nuts, in general, are among the richest dietary sources of unsaturated fatty acids, particularly MUFAs and PUFAs.

Among tree nuts, Brazil nuts exhibit one of the highest saturated fat contents—second only to coconuts—and surpass macadamia nuts in this regard. They also contain a notable proportion of omega-3 fatty acids, primarily α-linolenic acid, which constitutes approximately 7% of total fat content. The predominant lipid in Brazil nuts is monounsaturated fat, mainly oleic acid, followed by saturated fats such as palmitic and stearic acids, and polyunsaturated fats including linoleic acid (omega-6) (Maguire *et al.,* 2004: Ryan *et al.,* 2006)

**Micro-Nutrients**

Brazil nuts are recognized for their high concentrations of trace elements, which play a crucial role in human nutrition. Elements such as chromium (Cr), copper (Cu), and iron (Fe) function as essential cofactors in numerous metabolic and physiological processes. Typically, the elemental concentration in Brazil nuts follows the general descending order: magnesium (Mg) > calcium (Ca) > iron (Fe) > copper (Cu) > chromium (Cr) > arsenic (As) > selenium (Se). Notably, Brazil nuts are considered one of the richest dietary sources of selenium; however, significant variability exists in selenium content depending on the specific species and geographic origin of the nuts (Moodley *et al.,* 2007).Among various tree nuts, Brazil nuts demonstrate significantly higher selenium concentrations compared to cashew nuts, walnuts, and pecans (Kannamkumarath *et al.,* 2002).Brazil nuts are regarded as one of the most concentrated dietary sources of selenium, supplying approximately 160% of the United States Recommended Dietary Allowance (US RDA) for this essential trace element per serving (Yang,2009).Brazil nuts are rich in sulfur-containing amino acids, which can enhance the absorption of selenium and other essential minerals (SM SUN *et al.,* 1987).Nuts contain a substantial quantity of bound phenolic compounds, measured at approximately 123.1 ± 18.4 mg per 100 grams (Yang,2009).Brazil nuts contain appreciable levels of tocopherols, with concentrations of α-tocopherol, β-tocopherol, and δ-tocopherol reported as 5.73 ± 1.54 mg, 7.87 ± 2.15 mg, and 0.77 ± 0.66 mg per 100 grams, respectively (Maguire *et al.,* 2004;Ryan *et al.,* 2006).Phytosterols such as β-sitosterol, stigmasterol, and campesterol constitute approximately 95% of the total phytosterol content considered beneficial in the human diet. Brazil nuts are a notable source of these compounds, containing significant amounts of campesterol (26.9 ± 4.4 µg/g oil), β-sitosterol (1325.4 ± 68.1 µg/g oil), and stigmasterol (577.5 ± 34.3 µg/g oil). Additionally, Brazil nuts have been reported to possess the highest levels of squalene, with a concentration of 1377.8 ± 8.4 µg/g oil (Yang,2009).

**Health Benefits of Brazil Nuts**

Scientific studies have demonstrated that the regular consumption of Brazil nuts offers various health benefits, largely attributed to their rich content of both macro- and micronutrients, which serve as sources of functional and nutritional compounds. In this context, the substantial presence of amino acids, proteins, and selenium facilitates the formation of affinity interactions among these components, resulting in the development of an organic complex with enhanced bioavailability (Moodley *et al.,* 2007).Consumption of Brazil nuts has been shown to elevate plasma selenium levels; however, this increase has minimal impact on the functionality of high-density lipoprotein (HDL), lipid profiles, and apolipoproteins in humans (Strunz *et al.,* 2008).A single consumption of Brazil nuts by healthy individuals was associated with a sustained reduction in inflammatory markers (Kluczkovski *et al.,* 2015).Selenium, a trace mineral abundantly present in Brazil nuts, plays a critical role in maintaining human health. It is essential for optimal thyroid gland function and the proper operation of the immune system. Selenium serves as a key component of antioxidant enzymes, contributing to the body's defense against oxidative stress. Due to its potent natural anti-carcinogenic properties, selenium has garnered significant research interest. Experimental studies in animal models have demonstrated that elevated selenium levels may exert protective effects against the development of cancer (Combs, 2001).

Various studies investigating the anti-proliferative effects of different nut extracts on cell cultures have demonstrated dose-dependent inhibition and cytotoxicity against Caco-2 human colon carcinoma and HepG2 human liver carcinoma cell lines. Nuts exhibited a more pronounced inhibitory effect on the proliferation of Caco-2 cells compared to HepG2 cells. The total phenolic content present in Brazil nuts is thought to contribute partially to the observed reduction in cancer cell proliferation, indicating that the antiproliferative effects may be attributed to specific phenolic compounds or groups of phenolics within the nut extracts (Yang *et al.,* 2009).

**Table 1-Superfoods: Components and Health Benefits**

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| **Superfood** | **Key Components** | **Health Benefits** |
| Brazil Nuts | Selenium, Phenolic compounds | Antioxidant activity, thyroid support, anti-cancer |
| Blueberries | Anthocyanins, Vitamin C | Anti-inflammatory, cognitive function, heart health |
| Kale | Vitamins A, C, K; Fiber | Bone health, immune support, detoxification |
| Quinoa | Complete protein, Fiber, Magnesium | Muscle repair, digestion, cardiovascular health |
| Salmon | Omega-3 fatty acids, Vitamin D | Heart health, brain function, anti-inflammatory |
| Turmeric | Curcumin | Anti-inflammatory, antioxidant, joint health |
| Chia Seeds | Omega-3 fatty acids, Fiber | Digestive health, cardiovascular support |
| Spinach | Iron, Folate, Vitamin K | Blood health, energy metabolism, bone health |

(Source-World Health Organization. <https://www.who.int/>)

**Amla**

Amla (*Emblica officinalis*), also known as *Phyllanthus emblica* or Indian gooseberry, is a prominent medicinal plant from the family Euphorbiaceae and is widely recognized in Ayurvedic medicine for its therapeutic potential. It is well-regarded for its rich nutritional profile and is a source of various bioactive constituents. The fruit contains a diverse range of phytochemicals, including tannins, amino acids, mucic acid, flavone glycosides, alkaloids, sesquiterpenoids, phenolic glycosides, flavonol glycosides, phenolic acids, carbohydrates, and norsesquiterpenoids. These compounds contribute to its pharmacological efficacy and nutritional value (Variya *et al.,* 2020).*Emblica officinalis* is indigenous to the Indian subcontinent and is predominantly distributed across tropical and subtropical regions. Its natural habitat extends throughout South and Southeast Asia, including countries such as Sri Lanka, Pakistan, Uzbekistan, Malaysia, and China (Pardeshi *et al.,* 2014).All parts of *Emblica officinalis* are employed in the prevention and treatment of various ailments; however, the fruit, characterized by its globular shape, yellowish-green coloration, and smooth, fleshy texture, holds particular importance in traditional and folk medicine. In addition to its medicinal applications, the fruit is widely used in culinary practices, including the preparation of chutneys, pickles, and vegetable dishes. It is also processed into a traditional sweet preserve known as *murabba*, in which ripe fruits are soaked in concentrated sugar syrup over an extended period, allowing the aromatic compounds of the fruit to infuse into the syrup. Furthermore, ripe amla fruits are used to produce fresh juice, which is often marketed as a concentrate for the convenient preparation of diluted beverages (Baliga & Dsouza,2011).Amla fruit juice contains a significantly high concentration of vitamin C, measuring approximately 478.56 mg per 100 mL. This level is notably higher compared to the vitamin C content found in several other fruits, including apple, pomegranate, lime, Pusa Navrang grape, and Perlette grape.

**Table 2- Superfood and its bioactive components**

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| --- | --- | --- | --- |
| Superfood | Nutrient/Compound | Health Benefits | Reference |
| Moringa | Vitamin C, calcium, polyphenols | Antioxidant, anti-inflammatory, supports immunity and bone health | Leone *et al.,* 2015 |
| Chia Seeds | Omega-3, fiber, antioxidants | Supports heart health, digestion, and blood sugar control | Ullah *et al.,* 2016 |
| Quinoa | Complete protein, fiber, iron | Supports muscle repair, digestion, and anemia prevention | Repo-Carrasco *et al.,* 2003 |
| Spirulina | Protein, B12, chlorophyll | Enhances energy, detoxification, and immune response | Belay *et al.,* 1993 |
| Blueberries | Anthocyanins, vitamin C, fiber | Boosts brain function, reduces oxidative stress, supports heart health | Joseph *et al.,* 1999 |
| Turmeric | Curcumin | Anti-inflammatory, antioxidant, may reduce risk of chronic diseases | Aggarwal *et al.,* 2007 |
| Flaxseeds | Lignans, omega-3, fiber | Supports hormonal balance, heart health, and digestive health | Bloedon & Szapary, 2004 |
| Goji Berries | Polysaccharides, vitamin A, antioxidants | Supports eye health, immune system, and healthy skin | Amagase & Nance, 2008 |
| Matcha Green Tea | Catechins, especially EGCG | Enhances metabolism, concentration, and protects against cell damage | Graham, 1992 |
| Kale | Vitamin K, C, lutein, beta-carotene | Supports vision, bone health, and immune function | Podsedek, 2007 |

**Nutritional Composition of Amla**

**Macro-Nutrients**

The macronutrient composition of *Emblica officinalis* primarily includes carbohydrates (82.91 g/100 g), protein (6.04 g/100 g), dietary fiber (2.78 g/100 g), and fat (0.51 g/100 g). The amino acid profile of the fruit reveals the presence of several key amino acids, with glutamic acid (29.6%) being the most abundant, followed by proline (14.6%), aspartic acid (8.1%), alanine (5.4%), and lysine (5.3%). In the dried pulp portion of the fruit—separated from the seed—additional constituents have been identified, including gallic acid (1.32%), albumin (13.08%), tannins (13.75%), gum (3.83%), moisture (17.08%), crude cellulose (4.12%), and various minerals (Hasan *et al.,* 2011).

**Micro-Nutrients**

*Emblica officinalis* is recognized as a rich source of bioactive constituents, particularly alkaloids, tannins, and phenolic compounds. Its fruit juice contains an exceptionally high concentration of vitamin C, approximately 478.56 mg per 100 mL. When incorporated into other fruit-based products, amla significantly enhances their nutritional profile, particularly by increasing their vitamin C content (Jain & Khurdiya, 2004).The phytochemical analysis of *Emblica officinalis* fruit juice has revealed the presence of several bioactive compounds. Per 100 mL of juice, the concentrations of key phytoconstituents were reported as follows: chlorogenic acid (17.43 mg), gallic acid (37.95 mg), quercetin (2.01 mg), and ellagic acid (71.20 mg). These compounds contribute to the fruit’s antioxidant and therapeutic properties (Bansal *et al.,* 2014).A variety of phytochemical constituents have been isolated and identified in *Emblica officinalis*. These include ellagic acid, gallic acid, 3,6-di-O-galloyl-D-glucose, 1-O-galloyl-β-D-glucose, 3-ethylgallic acid, quercetin, chebulagic acid, 1,6-di-O-galloyl-β-D-glucose, corilagin, chebulinic acid, and isostrictiniin. These compounds are known for their significant pharmacological and antioxidant activities, contributing to the therapeutic potential of the fruit (Yang *et al.,* 2020).The flavonoid profile of *Emblica officinalis* includes compounds such as kaempferol 3-O-α-L-(6'-O-methyl)-rhamnopyranoside, quercetin, and kaempferol 3-O-α-L-(6'-O-ethyl)-rhamnopyranoside. These flavonoids contribute to the fruit’s antioxidant capacity and are associated with various health-promoting properties (Habib-ur-Rehman *et al.,* 2007).The mineral composition of *Emblica officinalis* fruit per 100 g includes phosphorus (159 mg), calcium (129 mg), magnesium (46 mg), iron (11 mg), potassium (2.54 mg), chromium (0.82 mg), zinc (0.23 mg), copper (0.22 mg), and nicotinic acid (0.2 mg). These minerals contribute to the fruit’s nutritional and therapeutic value (Variya *et al.,* 2016).

**Health Benefits of Amla**

The therapeutic significance of *Emblica officinalis* is attributed to its diverse pharmacological activities. The plant exhibits a broad spectrum of bioactive effects, including anti-inflammatory, antioxidant, adaptogenic, anticancer, nootropic, antidiabetic, antimicrobial, and immunomodulatory properties (Mirunalini & Krishnaveni, 2010).In addition to its therapeutic efficacy against a range of diseases, *Emblica officinalis* has been shown to contribute to the prevention of osteoporosis, hyperlipidemia, and several other health conditions (Patel & Goyal,2012).The potent antioxidant activity of *Emblica officinalis* is attributed to the presence of compounds structurally related to ascorbic acid, including pedunculagin, emblicanin A, emblicanin B, punigluconin, and gallic acid (Variya *et al.,* 2016).A clinical trial involving administration of *Emblica officinalis* powder over a 21-day period demonstrated significant reductions in fasting blood glucose and 2-hour postprandial glucose levels in diabetic subjects. Additionally, treatment with daily doses of 1, 2, or 3 g of *E. officinalis* powder resulted in decreased serum triglycerides (TG) and total cholesterol levels. Furthermore, an increase in high-density lipoprotein cholesterol (HDL-C) and a decrease in low-density lipoprotein cholesterol (LDL-C) were observed in both healthy and diabetic volunteers receiving 2 or 3 g of *E. officinalis* powder daily (Akhtar *et al.,* 2011).The antidiabetic effects of *Emblica officinalis* are primarily attributed to its key phytoconstituents, including corilagin, gallotannins, gallic acid, and ellagic acid. These compounds exert their therapeutic action largely through antioxidant-mediated free radical scavenging mechanisms (Mehta *et al.,* 2009).Numerous preclinical studies in animal models have demonstrated that *Emblica officinalis* possesses cardioprotective and anticoagulant properties, suggesting its potential utility in the prevention and management of various cardiovascular disorders. This protective effect is primarily attributed to its tannin content, specifically ellagic acid, emblicanin A and B, and corilagin (D'souza *et al.,* 2014).Various extracts of Triphala, an Ayurvedic formulation containing a high concentration of *Emblica officinalis*, have been evaluated for their antimutagenic potential using the Ames test with *Salmonella typhimurium* strains TA100 and TA98. The assay tested against direct-acting mutagens such as sodium azide and NPD, as well as indirect-acting pro-mutagens like 2-aminofluorene, in the presence of the hepatic S9 microsomal fraction derived from phenobarbital-induced rat liver. The results indicated that *E. officinalis* effectively inhibited mutagenicity induced by both direct and indirect mutagens (Kaur *et al.,* 2005).Multiple studies have investigated the hepatoprotective effects of *Emblica officinalis* against carbon tetrachloride (CCl₄)-induced acute liver injury. Results demonstrated that treatment with *E. officinalis* significantly reduced focal necrosis and inflammatory infiltration in hepatic tissue. Furthermore, histological analysis revealed restoration of normal liver architecture in treated subjects (Variya *et al.,* 2016).*Emblica officinalis* exerts anticancer effects by inhibiting activator protein-1 (AP-1) and targeting the translation of viral oncogenes involved in the progression of cervical cancer. This mechanism highlights its potential therapeutic application in the treatment of human papillomavirus (HPV)-induced cervical malignancies (Mahata *et al.,* 2013).

**Jackfruit**

Jackfruit (*Artocarpus heterophyllus* Lam.), a member of the Moraceae family, is primarily cultivated in India, followed by Bangladesh and various regions of Southeast Asia. It is considered one of the most prominent evergreen tree species found in tropical climates and is extensively grown across Asia, particularly in India. A medium-sized jackfruit tree typically attains a height ranging from 28 to 80 feet. The fruit commonly develops on both the main trunk and lateral branches. On average, the fruit weighs between 3.5 and 10 kilograms, although in some cases, it can reach up to 25 kilograms (Swami *et al.,* 2007).Jackfruit is regarded as a non-seasonal fruit with considerable potential to contribute to food security, particularly in regions experiencing shortages of staple food grains, and is therefore often referred to as the "poor man's food." Once the fruit reaches maturity, it must be consumed promptly to prevent the development of undesirable off-flavors. To ensure optimal quality and suitability for processing, it is generally recommended to harvest the fruit at a semi-ripe, firm stage before full ripening occurs on the tree. Post-harvest, the fruit should be stored under appropriate conditions until it softens and reaches a suitable state for consumption or processing (Ranasinghe *et al.,* 2019).Jackfruit seeds are recognized as a rich source of essential nutrients and are consumed either in their raw form or after undergoing various processing methods. They are commonly incorporated into a variety of culinary applications, including the preparation of traditional dishes, and their flour is frequently employed in baking formulations. The unripe jackfruit is typically utilized as a vegetable ingredient in savory preparations such as curries and salads, contributing both nutritional value and culinary versatility. In contrast, the ripe fruit is consumed in diverse forms, including raw, thermally processed (often prepared as a dessert with coconut milk), or as value-added products such as jackfruit-based confectioneries and edible fruit leathers (Swami *et al.,* 2007).In India, jackfruit seeds are traditionally consumed as a dessert, commonly prepared by boiling them in sugar syrup. Jackfruit is widely recognized for its high nutritional value and ranks third in terms of annual production among fruits in South India, following banana and mango. Both the seeds and pulp of jackfruit exhibit a superior nutritional profile, particularly with respect to calcium, protein, thiamine, and iron content, when compared to other tropical fruits such as papaya, pineapple, mango, orange, and banana (Baliga *et al.,* 2011).

**Nutritional Composition of Jackfruit**

**Macro-Nutrients**

Jackfruit (Artocarpus heterophyllus Lam.) is recognized for its nutritional value, particularly as a source of macronutrients. The edible portion of unripe (young) jackfruit, on a per 100 g basis, comprises carbohydrates ranging from 9.4 to 11.5 g, fats between 0.1 and 0.6 g, proteins from 2.0 to 2.6 g, dietary fiber in the range of 2.6 to 3.6 g, and provides an energy value of approximately 50 to 210 kJ, with a moisture content of 76.2 to 85.2 g. In contrast, the ripe fruit exhibits higher carbohydrate levels, varying from 16.0 to 25.4 g per 100 g, while fat and protein contents are slightly lower, ranging from 0.1 to 0.4 g and 1.2 to 1.9 g, respectively. The fiber content in ripe jackfruit decreases to 1.0–1.5 g, energy content ranges from 88 to 410 kJ, and water content varies between 72.0 and 94.0 g per 100 g (Goswami & Chacrabati, 2016). Jackfruit is characterized by a relatively low caloric density, providing approximately 94 kilocalories per 100 grams of edible portion (Mukprasirt & Sajjaanantakul, 2004).Several studies have reported variability in the protein and carbohydrate composition of jackfruit seeds across different cultivars, even when cultivated under identical regional conditions (Baliga *et al.,* 2011).The protein and carbohydrate content of jackfruit seeds varies among different species, ranging from 5.3% to 6.8% and 37.4% to 42.5%, respectively. Histological and chemical analyses have confirmed a substantial presence of starch within both the seeds and perianth regions of the fruit. The edible pulp of ripe jackfruit contains approximately 1.9 g of protein per 100 g. Research indicates that as the fruit matures, there is a corresponding increase in dietary fiber and starch content in the flesh. Additionally, jackfruit is recognized as a valuable source of essential amino acids, including cysteine, arginine, leucine, histidine, methionine, lysine, tryptophan, and threonine (Ranasinghe *et al.,* 2011).Jackfruit is recognized as a notable source of various minerals, containing calcium (31.28 mg), magnesium (36.96 mg), copper (0.38 mg), iron (3.26 mg), manganese (0.56 mg), and lead (0.20 mg) per 100 grams of the fruit (Ranasinghe *et al.,* 2011).Jackfruit exhibits a notably high potassium content, measuring 303 mg per 100 grams of fruit. The fruit also contains a diverse array of chemical compounds, primarily including morin, flavone pigments, cynomacurin, dihydromorin, isoartocarpin, artocarpin, cycloartocarpin, coxydihydroartocarpesin, artocarpesin, norartocarpetin, artocarpetin, artocarpanone, and cycloartinone (Swami *et al.,* 2012).Phytochemicals, particularly phenolic compounds, constitute a significant portion of jackfruit and play a crucial role in the development of value-added products. These compounds have potential applications in the food and nutraceutical industries aimed at promoting and sustaining human health

**Micro-Nutrients**

Jackfruit is a rich source of various micronutrients, including significant levels of riboflavin, vitamin C, vitamin A, thiamine, potassium, calcium, sodium, iron, niacin, and zinc (Mukprasirt, & Sajjaanantakul, 2004).In addition to its nutritional profile, jackfruit is recognized as an abundant source of various bioactive compounds, including flavonoids, carotenoids, tannins, and volatile sterols (Baliga *et al.,* 2011).Phytochemicals, particularly phenolic compounds, constitute a significant portion of jackfruit and play a crucial role in the development of value-added products. These compounds have potential applications in the food and nutraceutical industries aimed at promoting and sustaining human health ( Jagtap *et al.,* 2010).Jackfruit contains a total phenolic content of 0.36 mg GAE per 100 g dry weight (milligrams of gallic acid equivalent per gram of dry weight). Vitamin C is a significant constituent, present at concentrations ranging from 12 to 14 mg per 100 g of fresh fruit. Flavonoids, carotenoids, and related polyphenols, including glutathione and α-lipoic acid, represent a major category of nonenzymatic antioxidants. In addition to carotenoids, compounds such as lutein, lycopene, and beta-carotene are recognized as potent antioxidant (Swami *et al.,* 2012).The predominant carotenoids identified in jackfruit include all-trans-lutein, all-trans-β-carotene, all-trans-neoxanthin, 9-cis-neoxanthin, and 9-cis-violaxanthin, with their respective proportions ranging from 24–44%, 24–30%, 4–19%, 4–9%, and 4–10% (De Faria *et al.,* 2011).

**Health Benefits of Jackfruit**

The primary benefit of jackfruit consumption is attributed to its high vitamin C content. Since the human body cannot synthesize sufficient quantities of vitamin C, it is essential to obtain this nutrient through dietary sources. Vitamin C contributes to the neutralization of free radicals via its antioxidant properties, supports the maintenance of healthy gingival tissues, and plays a vital role in enhancing immune system function (Jagtap *et al.,* 2010). Jackfruit is rich in phytonutrients, including saponins, lignans, and isoflavones, which contribute to a variety of health-promoting effects. The fruit demonstrates antiulcer, antiaging, antihypertensive, and anticancer activities by inhibiting cancer cell proliferation, protecting against gastric ulcers, regulating blood pressure, and preventing cellular degradation, thereby promoting youthful skin appearance. Additionally, the niacin (vitamin B3) content in jackfruit plays a crucial role in energy metabolism, hormone synthesis, and the proper functioning of the nervous system (Swami *et al.,* 2012).The potassium content in jackfruit has been shown to aid in the regulation of blood pressure by counteracting the effects of sodium, which is known to elevate blood pressure and adversely affect cardiovascular health. Additionally, potassium contributes to the proper functioning of nerves and muscles and helps prevent bone loss. Furthermore, vitamin B6 present in jackfruit plays a role in reducing blood homocysteine levels, thereby lowering the risk of cardiovascular diseases (Fernando *et al.,* 1991).The presence of various micronutrients in jackfruit contributes to its potential health benefits. Iron (0.5 mg/100 g) plays a crucial role in facilitating efficient blood circulation by preventing anemia. Copper (10.45 mg/kg) is essential for thyroid gland metabolism, particularly in the synthesis and uptake of thyroid hormones. Magnesium, present at concentrations of 27 mg/100 g in the fruit and 54 mg/100 g in the seed, is a key nutrient involved in calcium absorption and works synergistically with calcium to strengthen bone structure and prevent bone-related disorders such as osteoporosis. Additionally, jackfruit supports regular bowel movements and helps prevent constipation due to its high dietary fiber content (3.6 g/100 g). It also protects the colonic mucous membrane by aiding in the removal of carcinogenic compounds from the large intestine (Swami *et al.,* 2012).Jackfruit exhibits a wide range of beneficial health effects, including anti-inflammatory, antioxidant, anticancer, and antibacterial properties. It also demonstrates potential in inhibiting melanin biosynthesis, exerting hypoglycemic activity, possessing antineoplastic effects, enhancing sexual function, and promoting wound healing (Baliga *et al.,* 2011).

**Conclusion**

Superfoods are predominantly plant-derived foods characterized by high nutritional density, providing substantial health benefits with relatively low caloric content. These foods are rich sources of vitamins, dietary fiber, minerals, and antioxidants. Due to their significant bioactive and nutritional properties, superfoods have the potential to contribute to the prevention and management of chronic diseases. Isolation and extraction of bioactive compounds from these foods, followed by their incorporation into various food matrices, present promising opportunities for the development of functional foods within the food processing industry. Increasing scientific evidence supporting the health-promoting effects of superfoods is expected to enhance consumer interest in these products. To substantiate the claimed benefits of superfoods, future research should prioritize well-designed human clinical trials. Additionally, regulatory agencies should establish standardized definitions for superfoods to facilitate clearer understanding and consistent communication within the scientific community and among consumers.

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