

SUPER-FRUIT: AS A POTENTIAL OPTION TO MITIGATE MALNUTRITION IN INDIAN SUBCONTINENT

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Received: 06 October 2015, Revised and Accepted: 01 November 2015

ABSTRACT

Health and wellness are key drivers of new product development, globally. Obesity and excess calories are issues on one extreme, and lack of nutrients is an issue at the other extreme. Consumers are also seeking out new kinds of indulgence, driving demand for new ethnic and exotic flavors, and authentic regional products. The health benefits of super-fruits have made them successful as ingredients for food companies and as a source of exciting new flavors for consumers. The super-fruits deemed super by nutrition scientists are packed with antioxidants, fiber, vitamins, minerals, and other nutrients that improve health condition. The importance of super-fruits as a necessary part of the human diet and as cash crops is well-recognized. They help to prevent a number of extremely chronic human diseases. In recent years, this term - originally used by the food industry to indicate fruit having an exceptional nutrient richness and nutritional qualities, including a high concentration of phytochemicals - has been increasingly and generically utilized, mainly for marketing purposes. In India, traditional fruits, such as bael, aonla, pomegranate, guava, pineapple, coconut, grapefruit, litchi, jackfruit, papaya, grape, and so many indigenous minor fruits, are rich in above-mentioned phytochemicals and antioxidant compound that include them in the list of super-fruit. In this present paper, we critically review the extraordinary-therapeutic characteristics of super-fruit, mainly to aware the common people and to speed-up the super-fruit cultivation.

Keywords: Super-fruits, Phytochemicals, Antioxidant, Malnutrition, Human health.

INTRODUCTION

Since time immemorial, edible fruits have played a very vital role in supplementing the diet of the people of the Indian Subcontinent. Apart from customary use as food, wild edible fruits have various health advantages as it potentially gives immunity to many diseases. India is one of the largest fruit producer and consumer in the world. Annually more than 88977 million ton fruits are produced from more than 7216 thousands of the area [1]. The nutrition value of fruits places them on the crest of our edibles. Nutrition scientists advise us to take at least 115 g of fruit every day for a balanced diet. But, at present, our country has the capacity to provide each of us with only 38 g of fruits every day. The rapid rise of degenerative diseases worldwide is threatening economic and social development as well as the lives and health of millions of people. It represents a major health challenge to global development in the coming century. It is estimated that up to 80% of cardiovascular disease, 90% of Type II diabetes, and one-third of cancers can be avoided by changing lifestyle, including diet [2]. Diet-related high cholesterol, high blood pressure, obesity, and insufficient consumption of fruits and vegetables have been cited as significant interlinking risk factors that cause the majority of these diseases [3]. Many phytochemicals found in fruits act as powerful antioxidants protecting cells and organs from damage caused by free radicals, neutralizing their damaging effects. They are the biologically active substances in plants that give them color, flavor, odor, and protection against not only diseases affecting the plants but also a human being. Consequently, hundreds of such plant substances are being investigated now for their role in preventing cancer and other degenerative diseases. Some of the promising phytochemicals which act as antioxidants are bioflavonoids (Vitamin P), phenolics, lycopene, carotenoids, antioxidant Vitamins (C and E), and glucosinolates. The world fruit market has evolved significantly over the past two decades. Aside from quality, the health benefits of fruit consumption have been used more frequently to promote various fruits. The term "super-fruits" has gained significant usage and attention in recent years as a

term synonymous with the marketing strategy to promote the health benefits of certain fruits which do not have worldwide popularity such as pomegranates, cranberries, and blueberries. In addition, the biodiversity of fruits, i.e., the individual varieties and cultivars, are attracting attention, as the nutrients and bioactive non-nutrients within species can vary dramatically. Fruit contain important nutrients and phytochemicals and are an essential component of balanced and healthy diets. They contribute to food security and provide key molecules such as vitamins, minerals, essential micronutrients, fiber, proteins, carbohydrates, and biofunctional components. In particular, their richness in phytochemicals and their benefits on health make them invaluable for physiological functions. They help prevent a number of extremely serious non-communicable chronic diseases, including cardiovascular diseases, diabetes, cancer, respiratory diseases, and obesity, as well as preventing micronutrient and vitamin deficiencies [4]. By keeping the fact of exceptional nutrient richness and ability to cure large numbers of human health hazards, a critical review in connection with the term super-fruit is made here, mainly to aware the common people about their locally available fruits having such extraordinary-therapeutic characteristics to speed-up the super-fruit cultivation and that may become a way for elimination of malnutrition from developing countries in the Indian subcontinent.

CHARACTERISTICS REQUIRED BY A FRUIT TO BE CONSIDERED AS A SUPER-FRUIT

- Nutritional composition to meet the daily requirements for optimal human growth and development due to presence of significant vitamin, fiber, micronutrient, and other nutrients
- Presence of extra nutritional composition (pharmacologically relevant levels of health-promoting secondary metabolites such as flavonoids such as anthocyanins, proanthocyanidins, and cinnamic acids), carotenoids, betalains, sesquiterpene lactones, and others that contribute to antioxidant, anti-inflammatory, enzyme modulatory, and other functional benefits after ingestion by humans as food

- Bioactive properties can be present in the flesh (edible portion) of the fruit or in pericarp or other tissues normally discarded as waste materials
- Unique flavors as well as taste, etc., that contribute to the appeal of the fruit
- Categorization as “exotic” or somehow unusual/not common place.

SCIENTIFIC PROOFS NEEDED TO SATISFY CATEGORIZATION OF A SUPER-FRUIT

Scientific substantiation of unique extra nutritional properties of a fruit was based on several levels of proofs, including:

- Historical use of a fruit for health benefits; traditional ecological knowledge regarding use of a fruit for medicinal purposes in a defined geographic area
- Epidemiological evidence suggesting that populations that consume a certain fruit have lowered incidence of chronic disease(s)
- Lab scale or *in vitro* (cell culture) bioassay results that indicate that a fruit extract was able to positively influence biomarkers relevant to human disease
- *In vivo* (animal-based) experiments that demonstrate that fruit extracts gavaged, topically-applied or fed to rodent or other animal subjects suppress disease outcomes or improve metabolism; and Clinical trials on human subjects (ideally, double-blinded crossover studies).

WORLDWIDE IMPORTANCE OF SUPER-FRUIT

Health and wellness are key drivers of new product development, globally. Obesity and excess calories are issues on one extreme, and lack of nutrients is an issue at the other extreme. Both are driving demand for healthier foods. Peoples are also seeking out new kinds of indulgence, driving demand for new ethnic and exotic flavors, and authentic regional products. Main health beneficial effects of super-fruit are:

- Multi-micronutrient malnutrition is a persistent problem of third world countries, affecting approximately two billion people. As a category of foods, fruits make a substantial contribution to the micronutrient intakes for populations in every country in the world
- National food-based dietary guidelines invariably recommend eating two or more servings of fruit every day. WHO guidelines for prevention of diet-related chronic diseases show convincing evidence that fruit consumption reduces the risk of obesity and heart disease, and there is probable evidence that fruit consumption decreases the risk of diabetes and many cancers
- In addition to conventional nutrients, fruits contain thousands of beneficial bioactive non-nutrients, with putative effects ranging from improving intelligence to increasing longevity.

Some world well-known super-fruits

Though there is no exact list of super-fruits, but scientific evidences worldwide make confirmation about superfluity characteristics of the following fruits: Acai Berries, Apple, Bananas, Black Berries, Blue Berries, Cantaloupe, Cherries, Lime, Cranberries, Dragon fruit, Grapes, Grapefruit, Kiwi, Oranges, Plums, Pomegranate, Strawberries, Avocados, Tomatoes, Papayas, Raspberries, Pumpkins, Watermelons, Pineapple, and Baobab.

Some Indian fruits having super-fruit characteristics

In India, fruits such as: Bael, Aonla, Pomegranate, Guava, Pineapple, Coconut, Grapefruit, Litchi, Jackfruit, Papaya, Grape, and some underutilized fruits such as Noni, Mangosteen, Kiwifruit, Persimmon, and Passion fruit, are rich in antioxidant compounds with potential phytochemical and therapeutical effect that include them in the list of super-fruit.

BIOACTIVE COMPOUNDS AND HEALTH BENEFITS OF MOSTLY ACCEPTED SUPER-FRUITS GROWN IN INDIA

Guava

Guava (*Psidium guajava* Linn.) is popularly known as poor man's apple of the tropics, has a long history of traditional use for a wide range of diseases (Table 1). The fruit, as well as its juice, is freely consumed for

Table 1: Worldwide ethnomedical uses of Guava

Country	Usage
Amazonia	For diarrhea, dysentery, menstrual disorders, stomachache, vertigo
Brazil	For anorexia, cholera, diarrhea, digestive problems, dysentery, gastric insufficiency, inflamed mucous membranes, laryngitis, mouth (swelling), skin problems, sore throat, ulcers, vaginal discharge
Cuba	For colds, dysentery, dyspepsia
Ghana	Coughs, diarrhea, dysentery, toothache
Haiti	For dysentery, diarrhea, epilepsy, itch, piles, scabies, skin sores, sore throat, stomachache, wounds and as an antiseptic and astringent
India	For anorexia, cerebral ailments, childbirth, chorea, convulsions, epilepsy, nephritis, jaundice
Malaya	For dermatitis, diarrhea, epilepsy, hysteria, menstrual disorders
Mexico	For deafness, diarrhea, itch, scabies, stomach-ache, swelling, ulcer, worms, wounds
Peru	For conjunctivitis, cough, diarrhea, digestive problems, dysentery, edema, gout, hemorrhages, gastroenteritis, gastritis, lung problems, PMS, shock, vaginal discharge, vertigo, vomiting, worms
Philippines	For sores, wounds and as an astringent
Trinidad	For bacterial infections, blood cleansing, diarrhea, and dysentery

Source: Kamanth et al. (2008) [9]

its great taste and nutritional benefits. Much of the traditional uses have been validated by scientific research [5]. Guavas are often included among super-fruits, being rich in dietary fiber, Vitamins A and C, folic acid, and the dietary minerals, potassium, copper, and manganese. Having a generally broad, low-calorie profile of essential nutrients, a single guava (*P. guajava*) fruit contains about four times the amount of Vitamin C as an orange [6]. Although the strawberry guava (*P. littorale* var. *cattleianum*), notably containing 90 mg of Vitamin C per serving, has about 25% of the amount found in more common varieties, its total Vitamin C content in one serving still provides 100% of the Dietary Reference Intake for adult males [7]. Guavas contain both carotenoids and polyphenols are the major classes of antioxidant pigments giving them relatively high potential antioxidant value among plant foods. As these pigments produce the fruit skin and flesh color, guavas that are red-orange have more pigment content as polyphenol, carotenoid and pro-Vitamin A, retinoid sources than yellow-green ones [8].

Bael

Bael (*Aegle marmelos* L corr.) is native to India and a sacred plant to Hindus. It has got immense medicinal values. All the parts of the plant are useful and used in ayurvedic medicines. Ripe bael fruit is one of the best known natural laxatives. Unripe or half-ripe fruit is very useful in treating chronic diarrhea and dysentery. It is also used for the treatment of hepatitis, tuberculosis, colitis, and dyspepsia. The fruit is also regarded as a heart and brain tonic. The raw fruit is an appetizer. The pulp of raw fruits is effective in treating bleeding piles and bacillary dysentery. Some of the important coumarins present in bael are marmelosin, marmesin, imperatorin, marmin, alloimperatorin, methyl ether, xanthotoxol, scoparone, scopoletin, umbelliferone, psoralen, and marmelide [10]. Marmelosin, skimmianine, and umbelliferone are the therapeutically active principles of bael [11]. Bael stimulates the production of bile, restorative, increases body's resistance, immunity, and improves digestion. Bael extracts are used to control cholesterol, blood urea and also useful in relieving constipation [12]. Bael inhibited *in vitro* proliferation of human tumor cell lines including the leukemic K562, T-lymphoid Jurkat, Beta-lymphoid Raji, and Erythro leukemic HEL [13].

Aonla

Aonla (*Emblca officinalis* L.), commonly known as amla is widely distributed in tropical and subtropical areas and has therapeutic

potential against deleterious diseases. Important chemical compounds isolated from amla were gallic acid, ellagic acid, 1-O-galloyl-beta-D-glucose, 3, 6-di-O-galloyl-D-glucose, chebulinic acid, quercetin, chebulagic acid, corilagin, 1, 6-di-O-galloyl beta D-glucose, 3 Ethylgallic acid (3 ethoxy 4, 5 dihydroxy benzoic acid), and isostrictiniin [14]. Fruit juice of amla contains the highest Vitamin C (478.56 mg/100 mL) which is same amount in two oranges. It also increases the red blood cell count and helps to promote good health [15].

Pomegranate

Pomegranate (*Punica granatum* L.), a native of Iran to Himalayan region, is extensively grown in Iran, Spain, India, and the USA [16] gains high consumer acceptability due to its excellent flavor, color, physico-chemical constitution, and therapeutic properties. Pomegranate is rich in biflavonoides and organic acids such as anthocyanins, ascorbic acid, ellagic acid, gallic acid, caffeic acid, catechin, Minerals, amino acids, quercetin, and rutin [17]. The therapeutic properties of pomegranate are reported to be due to the presence of betulinic and urosolic acids and also different alkaloids such as pseudo pelletierine, pelletierine, and some other basic compounds [18]. Pomegranate anthocyanin has potential antioxidant activities. The polyphenolic compounds of pomegranate are able to elevate the antioxidant capacity of the human body. Pomegranate fruit is also known for its anti-inflammatory and anti-atherosclerotic effect activity against osteoarthritis, prostate cancer, heart disease, and HIV-I [19,20]. There has been a remarkable increase in the commercial farming of the pomegranates globally, due to the potential health benefits of this fruit such as its high antioxidant, anti-mutagenic, anti-hypertension activities, and the ability to reduce liver injury [21].

Grape

Grape (*Vitis vinifera*) is one of the ancient crops linked with human history during the evolutionary development of man. Epidemiological studies demonstrated the moderate amount of red wine made from grape juice intake has the beneficial effect of on the neurodegenerative process [22]. Resveratrol is naturally occurring in grapevines where it is almost exclusively synthesized in berry skins, but in muscadine grapes it is found also in seeds [23]. The content of this substance in red grapes is higher than in white ones. Total resveratrol content in 100 g red grape varies between 0.15 mg and 0.78 mg. It is estimated that fresh grape skins contain between 50 and 100 µg resveratrol per gram wet weight [24]. Resveratrol shows its potentiality in cardioprotectivity, curing neurological disorder, Alzheimer's disease, Parkinson's disease and Huntington's disease, longevity, and anti-ageing properties. Iriti et al. (2006) [25] discovered another key substance in grape is "Melatonin," which is considered for one of the most powerful antioxidants involved in various physiological functions in the human body [26].

Grapefruit

Grapefruit (*Citrus paradisi*) is an important member of *Citrus* genus Rutaceae family. Grapefruit pulp contains significant levels of Vitamin C; potassium, folate, calcium, and iron. The pink and red varieties also contain beta-carotene and lycopene, antioxidants that the body can convert to Vitamin A. Other protective plant chemicals found in grapefruits include phenolic acid, limonoids, terpenes, monoterpenes, D-glucaric acid, and flavonoids including hesperetin and naringenin. Grapefruit has been used as a folk medicine in many countries as antibacterial, anti-fungal, anti-inflammatory, antimicrobial, antioxidant, antiviral, astringent, and preservative. It has also been used for cancer prevention, cellular regeneration, lowering cholesterol, cleansing, detoxification, heart health maintenance, Lupus nephritis, and rheumatoid arthritis and weight loss. It is reported that the 6, 7-dihydroxy-bergamottin, a bioactive compound found in *C. paradisi* enhances bioavailability of HIV protease inhibitor by inhibiting cytochrome P450 iso-enzyme 3A4 in liver and gut [27,28]. In humans, *C. paradisi* juice decreased diastolic arterial pressure and systolic arterial pressure both in normotensive and hypertensive subjects [29]. In Sudan internal fruit peel of *C. paradisi* is used to treat

for malaria, gastro protective and antiulcer and this action is attributed to the antioxidant activity of citrus flavonoids found in grapefruit such as naringenin because this major flavonoid found exhibited the potent antibacterial and anti-helicobacter pylori activity *in vitro* and was also recently implicated in cytoprotection against injury induced by algal toxins in isolated hepatocytes. Moreover, naringenin, the bioactive component showed gastro protective activity due to increasing expression of prostaglandins biosynthesis. Furthermore, it was shown to exhibit anticancer activity against human breast cancers. Therapeutic efficacy of citrus fruits such as red grapes and grapefruits is emphasized by the fact that they contain different classes of polyphenolic flavonoids, which were shown to inhibit platelet aggregation thus decreasing the risk of coronary thrombosis and myocardial infarction [30].

Mangosteen

Mangosteen (*Garcinia mangostana*) is a tropical fruit has been used as a traditional indigenous medicine across Southeast Asian countries such as Thailand, Malaysia, Taiwan, Philippines, Indonesia, Sri Lanka, and also India for the treatment of a wide range of ailments including fighting infections, healing wounds, and treating diarrhea and related gastrointestinal complaints. The pleasant taste (sweet and slightly acidic) and medicinal qualities of the reddish-purple Mangosteen fruit have led to its common name as "Queen of Fruits" [31]. Mangosteen is known to contain a wide range of naturally occurring polysaccharide and xanthone compounds within the fruit, leaves, heartwood, and especially in the pericarp with widespread biological activities including anti-inflammatory [32], antioxidant [31], antiproliferative [33,34], immune-stimulatory, etc. [35]. The major xanthone in mangosteen is alpha-mangosteen, has shown antiparasitic activity [36] and anti-larval activity [37] *in vitro*. In cell culture, alpha-mangosteen induces apoptosis in a variety of human cancer cell lines [38,39]. Mangosteen has shown antibacterial effects (*in vitro*) against *S. aureus* [40] and *M. tuberculosis* [41] as well as a range of antibiotic-resistant strains of bacteria.

Kiwi fruit

Kiwi fruit (*Actinidia deliciosa*) is a highly nutritional fruit due to its high level of Vitamin C and its strong antioxidant including carotenoids, lutein, phenolics, flavonoids, and chlorophyll. Kiwi fruit is a rich source of Vitamins E, fructose, galactose and minerals, its contains isoflavones and flavonoids which are important phytochemical in kiwi extract and represent the major class of phytosterogen, which has an important function as anticarcinogenic, neuroprotective, and cardio protective activity. Recent studies have shown that kiwi fruit has antioxidant, cardiovascular protective. Extracts of kiwi fruit inhibit cancer cell growth and exhibit cell protection against oxidative DNA damage *in vitro* [42]. In ancient China, kiwi fruits were used for symptom relief of numerous disorders such as digestive problems, rheumatism, dyspepsia, and hemorrhoids, as well as a therapy for various cancers and also used to increase complete spontaneous bowel motion, improve transit time and rectal sensation.

PROSPECTS OF SUPER-FRUIT CULTIVATION IN INDIA

India is endowed with diverse agro-climatic conditions, which can help prolonged supply of fruit crops from various parts of the country. Likewise, a gamut of fruit crops ranging from temperate, tropical, and subtropical to arid zone fruit crops can be grown in India.

- More waste lands can be brought under fruit cultivation which is hitherto unsuitable for growing any other agricultural crops
- Development and adoption of new production technologies have now made it possible to grow crops in non-conventional areas.

GOVERNMENT INITIATIVE AND POLICIES TO MOTIVATE SUPER-FRUIT CULTIVATION AND CONSUMPTION

As we know India is endowed with the diverse agro-climatic condition, so there is the immense scope of cultivate most of the super-fruit grown worldwide. Recently, Government of India introduces some crop diversification scheme namely:

- National food security mission
- Rashtriya krishi vikas yojana
- National horticulture mission
- Horticulture Mission for the North-East and Himalayan States.

Through above-mentioned scheme if central and state Government takes the initiative to provide planting materials of super-fruit (species and cultivars well fitted to local region) to the rural people belonging from below poverty line category with no-cost or subsidiary - cost along with the general care and management information for proper growth and yield. Government also takes initiatives like:

- Broad-cast the importance of super-fruit and motivate to take such fruit in daily diet for healthy life
- Government may purchase super-fruit for value addition from the farmers or its association and then distribute it in subsidiary rate to the highly imposed malnutrient region of the country.

CONCLUSION

Although the promise of nutritional and extra nutritional benefits is inherent in the super-fruits category, it is quite difficult to preserve these benefits in the routine daily diet. For many, the cost and availability of fruits are a limitation. Seasonal availabilities and high costs outside of local seasons are other constraints. Continuous Government and Non-Government support is required to popularize the cultivation and consumption of super-fruit at rural farm-household level. Further research is required to explore the extra nutritional properties of such super-fruits.

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