Nutritional and health benefits of apricots

Tabasum Fatima, Omar Bashir, Gousia Gani, Tashooq A Bhat and Nusrat Jan

Abstract
Advances in food and nutrition have shifted the consumer preferences towards functional and nutraceutical rich foods. In addition to natural antioxidant defence system, there are external sources furnished via diet to quench free radicals and reactive oxygen species produced in the biological systems. Apricot occupies a distinct position among stone fruits due to its multifaceted compositional contour and significant functional potentials. It has a rich nutritional content in terms of sugars (more than 60%) proteins (8%), crude fiber (11.50%), crude fat (2%), total minerals (4%), vitamins (vitamin A, C, K and B complex) and reasonable quantities of organic acids (citric acid and malic acid) on dry weight basis. Literature reports that there are appreciable amounts of total phenolic compounds and flavonoids in the fruit which make them more valuable as functional food. The fruit has a great market value as fresh and dried food commodity and has the highest market share of agricultural income. The plant is reported to contain polysaccharides, polyphenol, fatty acid, sterol derivatives, carotenoids, cynogenic glycosides and volatile component. In very small amounts, the hydrogen cyanide present in apricot kernels has been traditionally prescribed in Chinese medicine for treating asthma, cough, and constipation. Owing to its bioactive components of pharmacological importance, it has been found effective against chronic gastritis, oxidative intestinal damage, hepatic steatosis, atherosclerosis, coronary heart disease and tumor formation. The present review is an attempt to collect and disseminate available information regarding nutritional and health potentials in apricot for the benefit of researchers, consumers and other stakeholders.

Keywords: Apricots, bioactive composition, free radicals, functional foods, and phytochemicals

1. Introduction
Apricot (Prunus armeniaca L.) belongs to family Rosaceae. In angiosperms, Rosaceae is one of the largest families having about 3,400 species including almonds, peaches, apples, plums, cherries and berries, distributed throughout the northern temperate regions of the globe. Apricot has been named by Romans most probably from the mixed accent of two words “praecocia” from Latin meaning “early matured”, or “albarquq” from Arabic, meaning short ripening period. It is a temperate fruit and grown in climates with well-contoured and significant functional potentials. It has a rich nutritional content in terms of sugars (more than 60%) proteins (8%), crude fiber (11.50%), crude fat (2%), total minerals (4%), vitamins (vitamin A, C, K and B complex) and reasonable quantities of organic acids (citric acid and malic acid) on dry weight basis. Literature reports that there are appreciable amounts of total phenolic compounds and flavonoids in the fruit which make them more valuable as functional food. The fruit has a great market value as fresh and dried food commodity and has the highest market share of agricultural income. The plant is reported to contain polysaccharides, polyphenol, fatty acid, sterol derivatives, carotenoids, cynogenic glycosides and volatile component. In very small amounts, the hydrogen cyanide present in apricot kernels has been traditionally prescribed in Chinese medicine for treating asthma, cough, and constipation. Owing to its bioactive components of pharmacological importance, it has been found effective against chronic gastritis, oxidative intestinal damage, hepatic steatosis, atherosclerosis, coronary heart disease and tumor formation. The present review is an attempt to collect and disseminate available information regarding nutritional and health potentials in apricot for the benefit of researchers, consumers and other stakeholders.
juices, nectars and extruded products (Chauhan et al., 2001) 13]. In addition, apricot kernels are considered to be an excellent source of quality oil, being used for cooking purpose, production of cosmetic products, benzaldehydes and active carbon. The current trends in nutrition sciences have attracted the consumers towards consumption of health foods especially fruits and vegetables to fulfill their nutritional needs and maintain a healthy life. The present paper therefore aims to explore and summarizes the available research information on apricot fruit regarding its nutritional and health benefits.

Nutritional Significance
Among stone fruits, apricot is a carbohydrate-rich commodity and is good source of fibers, minerals and vitamins. Carbohydrate concentration in fresh apricots ranges from 11-13% and provides 50 kals of energy per 100g on fresh weight basis (Lecce et al. 2007) 27]. It is also rich in bioactive phytochemicals that have certain roles in the biological system and effective in preventing oxidative stresses (Lecce et al., 2011) 28]. Apricot also carries a reasonable amount of dietary fiber that ranges from 1.5-2.4g/100g on fresh weight basis (Ali et al. 2011) 4]. Fiber provides necessary roughage and bulk to the food consumed, stimulates normal gastric mobility and prevents constipation, as animal model studies of apricot significantly improved faecal output (Akin et al. 2007; Tamura et al. 2011) 3, 44]. Soluble fiber lowers blood cholesterol, maintain blood sugar level and helps in reducing body weight. Apricots contain varied amounts of essential minerals The major elements are potassium, phosphorus, calcium, magnesium, iron and selenium (Munzuroglu et al., 2003; Ali et al.,2011) 49], while sodium, manganese, zinc and copper are also present in small amounts (Lichou et al., 2003; USDA, 2010) 30, 45]. Similarly, the vitamins found in apricot are pro-vitamin A, vitamins C, K, E, thiamin (B1), riboflavin (B2), niacin (B3), pyridoxine (B6), folic acid (B9) and pantothenic acid. Apricot contains organic acids i.e. malic acid (500-900mg/100g) and citric (30-50mg/100g) as the major acids (Gurrieri et al., 2001), while presence of tartaric, succinic, oxalic, galacturonic, quinic, malonic, acetic and fumaric acid has also been reported (Hasib et al., 2002) 20]. From a nutritional point of view, organic acids maintain acid base balance in the intestine and improve bioavailability of iron. Proteins and fats are found in minute quantities in the flesh; however, apricot kernel has appreciable amounts of the both, 20-30% and 40-52% respectively (Alpaslan and Hayta, 2006).Average ranges of protein and fat in apricot fruit is 1.4-2.0% and 0.4-0.6% respectively. The oil content of seed ranges from 40-52%, which is rich in unsaturated fatty acids (Alpaslan and Hayta, 2006) 6].

Phytochemicals in Apricot
Apricot fruit contain different levels of phytochemicals such as aspolyphenols (phenolic acids and flavonoids) and carotenoids that contribute significantly to their taste, colour and nutritional value (Dragovic-Uzelac et al. 2007) 14].

Phenolic compounds
Phenolic compounds are important plant chemicals and play important roles in the living systems. There is considerable interest in polyphenols and carotenoids because of their antioxidant properties and possible ability to alleviate chronic diseases (Gardner et al. 2000) 16]. Apricots contain phenolic compounds (phenolic acids and flavonoids) and total phenolic composition has been reported in the range of 50.00-563.00mg GAE/100g on fresh weight basis (Ali et al. 2011) 4]. Their concentration normally increases with the maturity of fruit and attains maximum accumulation at fully ripened stage; however, some phenolic constituents decrease with the stage of maturity (Dragovic-Uzelac et al. 2007) 14]. Similarly, some studies have even shown high concentrations of phenolics in unripe fruits (Kalyoncu et al. 2009) 23]. The phenolic acids such as chlorogenic, neochlorogenic, isochlorogenic, caffeic, β-coumaric, p-coumaric and ferulic acids derivatives are the most common found in apricot (Sass-Kiss et al., 2005) 45]. Total flavonoid content determined in apricot has been reported in the range of 1.00-12.00mg/100g on fresh weight basis (Miguel et al., 2008). The main flavonoids are flavanols, anthocyanins and flavonols respectively. Akbulut and Artik (2002) have reported catechins as the most common phenolic compound in apricots from Turkey. Similarly, chlorogenic acid has been reported as the major phenolic compound from Croatian apricots (Dragovic-Uzelac et al. 2007) 14]. Flavonoids in apricots mostly occur asglycosides and rutinosides of quercetin, kaempferol and rutin.

Carotenoids
Carotenoids are bioactive compounds and the most widespread group of pigments in nature and are present in all photosynthetic organisms. They are responsible for yellow to red colors of fruits and flowers (Rao and Rao, 2007) 38]. Carotenoids act as antioxidants through scavenging the reactive oxygen species that cause oxidative damage to living cells. They are possibly vital in preventing many human degenerative disorders and maintaining good health (Bromley, 2003) 10]. Apricot is among the carotenoid-rich fruits and the content ranges from 2.00-20.77mg/100g of β-carotene (Ali et al. 2011) 4]. The major dietary carotenoids are β-carotene, γ-carotene and lycopen, among them β-carotene represents more than 50% of total carotenoids. Other carotenoids reported in apricot fruit include, β-cryptoxanthin, lutein, phytoene, phytofluene and zeaxanthin. Apricot is an excellent source of β-carotene, the main carotenoid that is precursor of vitamin A and confers orange color to the fruits (Ruiz et al., 2005) 40]. Apricots can be important dietary sources of pro-vitamin A, because 250g of fresh or 30g of dried apricots supply enough carotenoids that fulfill the body requirements of vitamin A (Marty et al. 2005) 31].

Functional Properties of Apricot
There is an increasing demand by the consumers for foods that not only fulfill the basic need of nutrition but additionally perform a disease preventive and curing role. According to Karla (2003) 25], “functional foods aid in the prevention and treatment of diseases”. The food components meeting this purpose are mostly phytochemicals that are being explored and studied for their potential roles in the body. These compounds alleviate risk of free radicals that cause oxidative damage to the living cells and result into common degenerative disorders like cancer and cardiovascular diseases (Boyer and Liu, 2004) 4]. Amongst, phenolic compounds are considered to be very important as antioxidants. Their antioxidant properties include; anti-carcinogenic, anti-oxidant, anti-tumoral, anti-microbial,
anti-aggregant, anti-ischemic, anti-allergic, anti-mutagenic and anti-inflammatory as well as effective in alleviating cardiovascular diseases. Furthermore, certain functional foods have been associated with improved mental capacity (Howlett, 2008) [21], immunity and with anti-aging benefits. Apricot fruit in this context may be considered as a functional food having appreciable amounts of biologically active phytochemicals.

**Antioxidant capacity of apricot**

Oxidative stresses, due to production of reactive oxygen species and free radicals cause damage to macromolecules (protein, lipids and nucleic acids) and tissue injuries. These conditions further lead to pathogenesis and chronic disorders, including cancer, inflammations, ulcers, diabetes and cardiovascular diseases (Halliwell and Aruoma, 1991) [21]. The antioxidant properties of apricot fruit are attributed to its rich phytochemical composition. Numerous studies have revealed the potential of apricot to be considered as a functional food based on its free radical scavenging activities (Leccese et al. 2007) [27].

**Apricot as folk medicine**

Apricot has been used as a popular home remedy in China and among the mountainous inhabitants of Himalayas for centuries. The folk describes apricot as analgesic, anthelmintic, antisthmatic, antipyretic, antiseptic, antispasmodic, demulcent, emetic, emollient, expectorant, laxative, ophthalmic, pectoral, sedative, tonic and vulnerary. Apricot fruit in Chinese medicine is thought to be useful in regenerating body fluids, detoxifying and quenching thirst, while kernels for toning respiratory system and alleviating cough (Kan and Bostan, 2010) [24].

**Role of apricot in degenerative diseases**

**Cancer**

Cancer is the most common degenerative disease today and the second cause of deaths in the USA after cardiovascular diseases (Borek, 2004) [8]. A number of pharmacological or physiological factors are responsible for the incidence of apoptosis (Noonan et al. 2007) [30]. Neuhouser (2004) [35] reviewed association of flavonoid intake with cancer insulation and concluded that there is substantial evidence regarding the role of flavonoids in reducing the risk of lung cancer. Apricots in a number of studies have shown anti-carcinogenic potential. Enomoto et al., (2010) [15] have established that consumption of 3 Japanese apricots daily has an inhibitory effect on mucosal inflammation in the stomach and chronic gastritis progressions related to Helicobacter pylori infection. Miyazawa et al., (2006) [33] investigated the role of (+)-Syringaresinol, a compound isolated from unripe Japanese apricot in the motility inhibition of H. Pylori. Similarly, fruit juice concentrates of Japanese apricot prevented H. pylori induced glandular stomach lesions in Mongolian Gerbils (Otsuka et al., 2005) [37]. A compound extracted from a Japanese apricot variety “MK615” has also shown anti-tumor activity against human pancreatic cancer cells, colon cancer cells and liver cancer cells in laboratory trials. Apricot and other prunacian family seeds have been used in a number of pathological disorders like asthma, bronchitis, emphysema, leprosy, colorectal cancer, leucoderma and pain (Chang et al. 2005) [12]. The oil of apricot was also used in England during the 17th century to treat ulcers and tumors (Lewis et al. 2003) [29]. Human studies on the effect of aqueous amygdaline extracts from Armeniacae semen have shown apoptotic cell death of prostate cancer (Chang et al. 2006).

**Cardiovascular diseases**

Cardiovascular diseases are among the main causes of deaths all over the world. Associated risk factors include high cholesterol, high homocysteine level, atherosclerosis and many others (Schieber et al. 2001). Antioxidants have been found effective in combating coronary heart diseases (CHD). Phenolic components in apricots i.e. chlorogenic acid, β-carotene and lycopene prevent the oxidation of low density lipoprotein (LDL) and thus improve the antioxidant status of the body (Chang et al. 2006) [11]. Apricot supplies significant amounts of fiber (soluble and insoluble) (Ishaq et al. 2009) [22]. Soluble dietary fiber is effective in reducing LDL cholesterol by binding bile acids or cholesterol during intraluminal micelles formation; thus decreasing the content of cholesterol in liver cells and increasing clearance of LDL cholesterol (Aller et al.,2004) [5].

**Hepatic steatosis**

Hepatic steatosis is mainly resulted from intra-cellular accumulation of neutral fats in the liver tissues and is called as fatty liver disease (FLD). The occurrence of this disease in the general population may further lead to steatohepatitis, advanced fibrosis and cirrhosis (Angulo, 2002) [7]. Apricot has been shown to be effective in curing hepatic steatosis in animal models.

**Hemostasis**

Several epidemiological studies have shown that intake of dietary flavonoids and flavones are inversely associated with the risk of cardiovascular disease (Neuhouser, 2004) [35]. This may be due to the effect of these compounds on hemostasis, because flavonoids have been reported to inhibit platelet aggregation in vitro. Raw apricots contain 5.47 mg/100 g of flavon- 3-ol (-) epicatechin, 4.79 mg/100 g of flavon-3- ol (+) catechin and 2.08 mg/100 g of edible portion of flavonol (USDA, 2007) and studies have revealed that 2500 micromol/L of the flavonolquercetin and the flavone apigenin significantly inhibited collagen-induced and ADP-induced aggregation in platelet-rich plasma.

**Conclusion**

The scientific evidence reviewed regarding apricot’s nutritional and functional attributes reveals that it is a rich source of nutrients and biologically active compounds. These substances have crucial roles in disease prevention and health maintenance. The effectiveness of apricot against stomach inflammations, hepatic disorder, tumour formation and chronic heart disease suggests its use as a functional food. The present review in this regard will help researchers as a ready reference for further nutraceutical studies and entrepreneurs for industrial exploitation of the fruit for economic benefits.

**References**


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