APRICOT: NUTRITIONAL POTENTIALS AND HEALTH BENEFITS-A REVIEW

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ABSTRACT
Recent advances in food and nutrition have shifted the consumer preferences towards nutraceutical rich foods. In addition to natural antioxidant defense 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(highly rich in vitamin A, C, K and B complex) and reasonable quantities of organic acids (citric acid and malic acid) on dry weight basis.Literature reports appreciable amounts of total phenolic 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 in Gilgit-Baltistan province of Pakistan.Dried fruits are taken as an energy rich food in the mountainous Karakoram region and have many uses in folk medicine for treatment of cold, fever, 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.

Key words: apricot nutrition, bioactive composition, free radicals, antioxidants, pharmacological importance

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1.INTRODUCTION

Apricot (*Prunusarmeniaca* 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”, since apricots were ripen during early summer as compared to ancient Asian peaches or “albarquq” from Arabic, meaning short ripening period (Anonymus, 2008). It is a temperate fruit and grown in climates with well-differentiated seasons. It requires a fairly cold winter and moderately high temperatures in the spring and early summer(Ahmadi*et al.,* 2008;Guclu*et al.,*2006).

Botanically, apricots are drupes like peaches, plums, cherries and mangoes in which the outer fleshy part (exocarp and mesocarp) surrounds a hard stone (endocarp) with a seed inside. Fruit color ranges between orange to orange red and some cultivars are cream white to greenish white (Ruiz *et al.,*2005;Riu-Aumatell*et al.,*2005).Amongst the drupes, apricot and plum belongs to genus*Prunus*which is differentiated from other sub genera Amygalus, Cerasus and Padus in the shoots having a terminal bud and auxiliary buds being solitary. The flowers are sessile, white, with five regular sepals, petals and stamens that open early before leaves in the spring.
Apricot originated in China and its cultivation history dates back to 2000 BC (Crisosto*et al.,*1999; Faust *et al.,*1996). It gradually made its way through the Persian Empire in to the Mediterranean, where they were best adapted. This fruit has also been grown in mountainous

slopes of Asia and Europe for thousands of years.Spanish explorers introducedthis fruit to the new world and were planted in the gardens of Spanish missions in California (Faust *et al.,*1996).
Presently, the main apricot cultivation regions include a strip stretching from Turkey through Iran, the Himalayas, Hindukush to China and Japan. However, the largest production of world apricot is supplied from the Mediterranean countries (Lecceseet *al.,*2007).According to FAO statistics (2010), the world's largest producers are Turkey and Iran accounting for 21.6% and 14.7% of world apricot production respectively, followed by Pakistan, Uzbekistan, Italy, Algeria, Japan, Morocco, Egypt and Spain (Fig. 1).
Apricot being an attractive fruit is appreciated by consumers all over the world and has gained great economic importance over the years. It is consumed in fresh, dried and frozen forms or used for preparation of jam, jellies, marmalades, pulp, juices,nectars and extruded products (Chauhan *et al.,*2001; Chambroy*et al.,*1995).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 (Yildiz*et al.,*1994).
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. Fruits are good junction of nutritional and health promoting constituents. Besides basic nutritional contents, it carries significant amounts of antioxidant and phenolics compounds that have crucial pharmacological roles. The present paper therefore aims to explore and summarizes the available research information on apricot fruit regarding its nutritional and health benefits.

2. NUTRITIONAL SIGNIFICANCE

Among stone fruits, apricot is a carbohydrate-rich commodity and is good source of fibers, minerals and vitamins (Table 1, 2).Carbohydrate concentration in fresh apricots ranges from 11-13% and provides 50 kcalenergy per 100g on fresh weight basis (Lichou*et al.,*2003; USDA 2005; Haciseferogullari*et al.,*2007; Lecceseet *al.,*2007). It is also rich in bioactive phytochemicals i.e. polyphenols and carotenoids that have certain roles in the biological system and effective in preventing oxidative stresses (Leccese*et al.,*2011). These compounds also confer colors (red, blue and purple) to plant tissues and thus largely contribute to the visual quality of fruits (Mazza and Miniati, 1993).
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; Haciseferogullari*et al.,*2007). Fiber provides necessary roughage and bulk to the food consumed, stimulates normal gastric mobility and prevents constipation, as animal model studies of apricot fiber significantly improved fecal output (Akin *et al.,*2007; Tamura *et al.,*2011).Soluble fiber lowers blood cholesterol, maintain blood sugar level and helps in reducing body weight (Lairon, 1990).Furthermore, on the basis of its health benefits, fiber is being considered as a functional component and has created a great interest among functional food concepts (Pszczola, 1998).
Apricots contain varied amounts of essential minerals (Table 2). The major elements are potassium, phosphorus, calcium, magnesium, iron and selenium (Munzuroglu*et al.,*2003; Ali *et al.,*2011),while sodium, manganese, zinc and copper are also present in small amounts (Lichou*et al.,*2003; USDA, 2005). Similarly,the vitamins found in apricot are pro-vitamin A, vitamins C, K, E, thiamin (B_1), riboflavin (B_2), niacin (B_3),pyridoxine (B_6), folic acid (B_9) and pantothenic acid (Table 2) (Chauhan *et al.,*2001; Haciseferogullari*et al.,*2007). Overall, apricot is especially rich in vitamin A and C (Lee and Kader, 2000).
Apricot contains organic acids i.e. malic acid (500-900mg/100g) and citric (30-50mg/100g) as the major acids (Table 2) (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). From a nutritional point of view, organic acids maintain acid base balance in the intestine and improve bioavailability of iron (Monsen, 1982). Being natural components of many fruitsand vegetables, these acids give the fruits, flavour, taste, shelf stability byslowing down bacterial spoilage and perform crucial roles in maintaining quality and determining the nutritional value (Bassi*et al.,*1996).

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 (Femenia*et al.,*1995; Alpaslanand Hayta, 2006).Average ranges of protein and fat in apricot fruit is 1.4-2.0% and 0.4-0.6% respectively (Table 1). Despite of low amounts, apricot fruit contains many essential amino acids (USDA, 2005). Similarly, apricot seed contain important levels of dietary protein and significant amounts of oil and fiber (Monsen, 1982). The oil content of seed ranges from 40-52%, which is rich in unsaturated fatty acids (Alpaslanand Hayta, 2006; Orhan*et al.,*2008).

PHYTOCHEMICALS IN APRICOT

Apricot fruit contain different levels of phytochemicals such aspolyphenols (phenolic acids and flavonoids) and carotenoids that contribute significantly to their taste, colour and nutritional value (Table 3) (Dragovic-Uzelac*et al.,*2007).The information available on major phytochemical contents is summarized hereunder:

Phenolic compounds

Phenolics compounds are important plant chemicals and play possibly 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; Rice-Evans *et al.,*1997; Vinson *et al.,*1998).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 (Table 3) (Ali *et al.,*2011; Sochor*et al.,*2010; Kalyoncu*et al.,*2009; Akbulut and Artik, 2002).Certain factors are considered to be responsible for differences in the concentration of phenolics such as genotype, agro-climatic conditions, storage atmosphere and level of ripeness (Joshi *et al.,*1991; Spanos and Worlstad, 1990; Spanos and Worlstad, 1992).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). Similarly, some studies have even shown high concentrations of phenolics in unripe fruits (Kalyoncu*et al.,*2009).

The phenolic acids such as chlorogenic, neochlorogenic, isochlorogenic, caffeic, β-coumaric, p-coumaric and ferulic acids derivatives are the most commonfound in apricot (Fig. 3) (Radi*et al.,*1997; Sass-Kiss *et al.,*2005).Total flavonoid content determined in apricot has been reported in the range of 1.00-12.00mg/100g on fresh weight basis (Arts *et al.,*2002; 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). Flavonoids in apricots mostly occur asglycosides and rutinosides of quercetin, kaempferol and rutin (Fig. 2) (Garcia-Viguera*et al.,* 1994). The flavonoids include the purple, blue, red anthocyanins and the yellow anthoxanthins, which largely contribute to the visual quality of fruits (Mazza and Miniati, 1993).Some other flavonoids as coumarins, aesculetin and scopoletin have also been reported in apricot fruits (Fermandez de Simori*et al.,*1992). Anthocyanins are glycosylated anthocyanidins and there are six anthocyanidins frequently occur in the plants i.e. pelargonidin, cyanidin, peonidin, delphinidin, petunidin and malvidin (Karakaya*et al.,*2001). Properties of anthocyanins include a shifting of color with pH of the substrate. Thus many of the anthocyanins which are violet or blue in alkaline media become red upon addition of acid. Hence, different color of fruits is due to the pH of the substrate. Phenolics and flavonoids in addition to being potential antioxidants are important pigments and colour precursors found in apricots.

Carotenoids

Carotenoids are bioactive compounds and the most widespread group of pigments in nature and present in all photosynthetic organisms. They are responsible for yellow to red colors of fruits and flowers (Rao and Rao, 2007).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 (Bramley, 2003). Approximately 90% of carotenoids in the diet and human body are comprised of α-carotene, β-carotene, γ-carotene, lycopene, lutein and cryptoxanthin (Gerster, 1997).Apricot is among the carotenoid-rich fruits and the content ranges from 2.00-20.77mg/100g of β-carotene (Table 3) (Ali and *et al.,*2011; De Rigal*et al.,*2000; Ruiz *et al.,*2008).The major dietary carotenoids are β-carotene, *γ*-carotene and lycopene, 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 (Fig. 3) (Muller, 1997; Radi*et al.,*1997).

Apricot is an excellent source ofβ-carotene,the main carotenoid that is precursor of vitamin A and confers orange color to the fruits (Muller, 1997; Ruiz *et al.,*2005).The significance of β-carotene is mainly due to its prevalence in plant foods and high vitamin A activity in the body when consumed (Khachik*et al.,*1989).Vitamin A is necessary for epithelial tissues covering our body organs, eye-health, bone and teeth development, working of endocrine glands and its deficiency may prolong the course of infectious illnesses (Roberts and Sporn, 1984; DeLuca *et al.,*1972, Scrimshaw *et al.,*1968). Although, there is no recommended daily intake (RDI) for β-carotene, however, 3-6mg daily consumption is assumed to maintain a level of β-carotene in the blood related to lower the risk of chronic diseases (Gerster, 1997; De Rigal*et al.,*2000; Muller, 1997).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; Muller, 1996; Fraser and Bramley, 2004).

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 (Muller, 1997).According to Karla (2003), "functional foods aid in the prevention and treatment of diseases". The common term "functional food" goes far beyond the normal nutrition sense and is simply defined as "any food or food ingredient that has a positive impact on the individual's healthand alleviates orprevents a disease in addition to its normal nutritional functions" (Karla, 2003). 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; Halliwell, 1999; Kaur and Kapoor, 2001; Liu, 2003). 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 (Fig. 2) (De Rigal*et al.,*2000; Kim *et al.,*2003). Furthermore, certain functional foods have been associated with improved mental capacity (Meister, 2002; Howlett, 2008), immunity and with a slowing of aging (Ames *et al.,*1993).

Apricot fruit in this context may be considered as a functional food having appreciable amounts of biologically active phytochemicals. It has been used in therapeutic purposes for centuries in the areas where it was produced.

The emergence of new scientific evidence in the field of analytical techniques has enabled the food scientists to study the role of different food components. New ideas and terminologies have emerged such as medical foods, nutraceutical and functional foods. This phenomenon has attracted both the consumers and researchers.

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; Halliwell and Gutteridge, 1989).Foods rich in antioxidant activity are generally believed to be the best option in combating such disorders and health risks. The antioxidant properties of apricot fruit are attributed to its rich phytochemical composition. Phenolic compounds are responsible for the antioxidant activity of fruits due to their redox properties thatallow them to act as reducing agents, hydrogen donors, singlet oxygen quenchers and metal chelators (Macheix*et al.,*1999).Antioxidant potential of apricot has been thoroughly investigated through different *in vitro* assay systems by measuring the ability to reduce free radicals and comparing with standard reference compounds (Table 4). However, *in vivo* studiesare needed to assess the antioxidant potential and disease prevention role of the fruit.

The assay systems commonly used to assess antioxidant function are 2,2-diphenylpicrylhydrazyl (DPPH), ferric reducing antioxidant power (FRAP), 2,2-azinobis(3-ethylbenzothiazoline-6-sulphonic acid ($ABTS^{+}$), oxygen radical absorbance capacity (ORAC) and cupric ion reducing capacity (CUPRAC), ascorbate equivalent antioxidant activity (AEAC) (Ruiz, 2005; Leccese*et al.,*2007;Drogoudi*et al.,*2008). 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), however, variations in activity level has been recorded while comparingdifferent assay systems (Ruiz *et al.,*2005; Leccese*et al.,*2007;Kalyoncu*et al.,*2009).The differences might be attributed to genotype, maturity stage, geographical region and the reference compound used as standard.

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 lore describes apricot as analgesic, anthelmintic, antiasthmatic, antipyretic, antiseptic, antispasmodic, demulcent, emetic, emollient, expectorant, laxative, ophthalmic, pectoral, sedative, tonic and vulnerary (Pramer and Kaushal, 1982). 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). The rich nutritional composition of apricot having phytonutrients, saccharides, organic acids, minerals and vitamins is obviously the fundamental fact that this fruit is being used in folk medicine (Sochor*et al.,*2010; Kan and Bostan, 2010; Conev, 2003).

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). Immune system plays an important role in cancer incidence and inflammation, eventually causing the aggregation of cells due to disturbances in signaling pathways (Noonan *et al.,*2007). A healthy life style with high dietary intake of fruits and vegetables has consistently been associated with a reduced risk of various human cancers including those of the lungs, breast, prostate and colon (30-40%). Cell death can occur by either of two distinct mechanisms: necrosis (accidental cell death) and apoptosis (programmed cell death). A number of pharmacological or physiological factors are responsible for the incidence of apoptosis (Noonan*et al.,*2007; Block *et al.,*1992).

It is still unclear that which bioactive compounds in plant foods provide protective effects against these cancers, however, flavonoids have been of special interest (Neuhouser, 2004).Numerous *in vitro*and *in vivo* studies have suggested that flavonoids influence important cellular mechanisms related to carcinogenesis, including cell cycle control and apoptosis. There is limited data from studies on humans, however,Neuhouser (2004) reviewed association of flavonoids intake with cancer insurgence 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) 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. This infectionis a common cause of gastric disorders in human, including chronic active gastritis, peptic ulcers, intestinal metaplasia and cancers. Miyazawa and others (2006) investigated the role of (+)-Syringaresinol a compound isolated from unripe Japanese apricot in the motility inhibition of *H. Pylori*. The results showed 90% inhibitory activity of (+)-Syringaresinol against *H. Pylori* motility when used at a concentration of 500µg/ml (50µg/ml IC_{50} value).

Similarly, fruit juice concentrates of Japanese apricot prevented *H. pylori* induced glandular stomach lesions in Mongolian Gerbils (Otsuka *et al.,*2005). 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. On the basis of the above findings, further studies are underway to find out the possibility of some powerful anti-cancer drugs from Japanese apricot (Okada *et al.,*2008; Okada *et al.,*2007).

Several findings have well confirmed the contribution of oxidative stress in the pathogenesis of methotrexate (MTX) induced damage to the small intestine (Vardi*et al.,*2008). Studies on animal models (rats) to assess the potent protective effect of apricot and β-carotene onMTX-inducedoxidative intestinal damage have been carried out. Results revealed that single or combined application of apricot and β-carotene ameliorates all of these hazardous effects in antioxidant systems in MTX treated groups. The study concluded that apricot may protect the injury of oxidative stress and improve MTX-induced intestine damage at biochemical and histological levels (Vardi*et al.,*2008).

Fruits are believed to have a role in combating degenerative diseases due to their high contents of antioxidant compounds. 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). The oil of apricot was also used in England during the 17th century to treat ulcers and tumors (Lewis*et al.,*2003). Human studies on the effect of aqueous amygdaline extracts from Armeniacae semen have shown apoptotic cell death of prostate cancer (Chang *et al.,*2006).However, some clinical trials that involved laetrile did not produce any significant results. Based on a number of reasons National Cancer Institute United States have declared laetrile ineffective against cancer (Milazzo*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; Agarwal and Rao, 1998).Antioxidants have been found effective in combating coronary heart diseases (CHD). A diet rich in these compounds is assumed to offer protection against cardiovascular diseases and age related degenerative transformations, as suggested by epidemiological studies (Agarwal and Rao, 1998). phenolic components i.e. chlorogenic acid, β-carotene and lycopene prevent the oxidation of low density lipoprotein (LDL) and thus improve the antioxidative status of the body (Chang *et al.,*2006). This antioxidant mechanism reduces the risk of developing atherosclerosis and coronary heart disease (Agarwal and Rao, 1998;Bursch, 1992).

Apricot supplies significant amounts of fiber (soluble and insoluble) (Ishaq*et al.,*2009).Soluble dietary fiber is effective in reducing LDL cholesterolby binding bile acids or cholesterol during intraluminal micelles formation; thus decreasing the content of cholesterol in liver cells and increasing clearance of LDL cholesterol (Viuda-Martos*et al.,*; Anderson *et al.,*2000; Aller*et al.,*2004).Foods rich in antioxidants including flavonoids can inhibit LDL oxidation and thus hamper the formation of cell to cell adhesion factors, which are implicated in damage to the arterial endothelium and in the formation of blood clots (Beretz and Cazenave, 1988). Flavonoids may also affect the activity or the concentration of plasma coagulation or fibrinolysis factors such as fibrinogen, factor VII, and plasminogen (Beretz and Cazenave, 1991; Middleton and Kandaswami, 1992; Badimon*et al.,*1993). The formation of a thrombus in atherosclerotic coronary arteries gives rise to acute ischemic heart disease, and coagulation and fibrinolysis factors play a key role in the control of thrombus formation (Ross, 1993).

Parlakpinar*et al.,*(2009)carried out a study on demonstrating beneficial effects of apricot feeding on myocardial ischemia-reperfusion (I/R) injury in rats. The *in vivo* study in animal model showed a significant effect of apricot feeding and the infract sizes were found decreased up to 10-20% as compared to the control group. The antioxidant capacity of rat feed was also evaluated after apricot supplementation as total phenolic contents, DPPH radical scavenging and ferric reducing power as *in vitro* antioxidant capacities increased significantly. Previous studies support these findings that the intake of dietary flavonoids was associated with a reduced riskfor ischemic heart diseaseand stroke in several studies (Keli*et al.,*1996; Knekt*et al.,*1996; Hertog*et al.,*1995: Hertog*et al.,*1993).Two types of mechanisms have been proposed to explain this protective effect; inhibition of LDL oxidationand platelet aggregation (Rimm*et al.,*1996; Hertog*et al.,*1997).Results obtained by incubation of human platelets or animal cells with isolated flavonoids showed inhibition of platelet aggregation that may be the result of the suppressed cyclooxygenase activity (Ramaa*et al.,*2006; Howlett*et al.,*2008; Landolfi, 1984).

Hepatic steatosis

Hepatic steatosis is mainly resulted from intra-cytoplasmic accumulation of neutral fats in the liver tissues and is called as fatty liver disease (FLD). This disease is increasingly being recognized as a condition may lead to end-stage liver disease (Ismail, 2004).The liver stores fat and convert it into a form that is utilized by the body for energy during new cell formation. The occurrence of this disease in the general population may further lead to steatohepatitis, advanced fibrosis and cirrhosis (Angulo, 2002).This disease can occur due to heavy, chronic alcohol intake and called alcoholic fatty liver disease. The other possible cause of fatty liver disease is non-alcoholic steato hepatitis (NASH) include, malnutrition, diabetics, hepatitis C, jaundice and drugs/toxins (Valenti*et al.,*2006).The non alcoholic fatty liver disease affects 10-25% of general population in different countries and its prevalence increases to 57-75% in obese individuals. It occurs in all age groups with predominance in women (Patel, 2001; Hamama, 2001). Apricot has been shown to be effective in curing hepatic steatosis in animal models. Ozturk*et al.* (2009) conducted a study on protective effect of 10-20% apricot containing feed on carbon tetrachloride (CCl_4) induced hepatic steatosis on male Wister rats. CCl_4 caused increased oxidative stress on the liver of treated rats. After five month feeding of apricot containing feed, the results showed a significant decrease in the liver injury with apricot feeding. They concluded that dietary intake of apricot can reduce liver steatosis and damage caused by free radicals. This study is supported by many researchers who have claimed that dietary intake of vitamins, carotenoids and flavonoids are beneficial in protection against hepatotoxicity (Kumar *et al.,*2009; Hinds, 1997; We *et al.,*2004).

Hemostasis

Several epidemiological studies have shown that intake of dietary flavonoids and flavones were inversely associated with the risk of cardiovascular disease (Neuhouser, 2004).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 and washed platelets by almost 80-97% (Janssen *et al.,*1998). Flavonoids are also recognized to help the red blood cells in fighting stress caused by oxidation, may help shield red blood cells against reactive oxygen species (Hodgson and Croft, 2006), and provide support in regulating the immune system in the body (Krinsky, 1993).

For centuries, there has been a strong belief that foods and herbs have health-giving and curative properties. Presently, use of drugs is increasing to treat and alleviate diseases. However, with the increasing knowledge of nutrients and enhanced analytical capabilities at molecular levels, researchers have been enabled to explore the biochemical structures, functions and relationship of the myriad of chemicals that occur naturally in foods and their effect on the human body (Labuza, 1994). This fact necessitates the need to further concentrate on foods and their individual components to foster a better understanding of their role and functions in different disease preventive mechanisms. In depth studies will help to utilize this resource for the benefits of humanity.

Table 1: Proximate composition of apricot fruit

Ingredients	**Concentration** (g/100g FW)
Water	83.00
Carbohydrates	11.00-13.00
Protein	1.40
Fat	0.40
Crude fiber	1.50-2.40
Ash	0.74

FW= Data presented on fresh weight basis
Sources: Chauhan *et al*., 2001; Haciseferogullari*et al*., 2007; Akin *et al*., 2007; Gurrieri *et al*., 2001.

Table 2: Minerals, vitamins and organic acid composition of apricot

Minerals	**Concen-tration** (mg/100gFW)	**Vitamins**	**Concentration** (mg/100g FW)
Calcium (Ca)	14.00	Retinol (Vit. A)	1.56
Potassium (K)	296.00	Thiamin (B_1)	0.02
Chloride (Cl)	3.00	Riboflavin (B_2)	0.02
Copper (Cu)	0.09	Niacin (B_3)	0.86
Iron (Fe)	0.54	Pantothenic acid (B_5)	0.23
Magnesium (Mg)	8.00	Pyridoxine (B_6)	0.06
Manganese (Mn)	0.06	Folic acid (B_9)	8.60
Phosphorus (P)	19.00	Ascorbic acid (C)	5.00-10.00
Selenium (Si)	0.40	Tocopherol (E)	0.88
Sodium (Na)	1.00	Phylloquinone (K)	3.28
Zinc (Zn)	0.26	**Organic acids**	
		Citric acid	38.11
		Malic acid	952.00

FW= Data presented on fresh weight basis
Sources: Ali *et al*., 2011; Chauhan *et al*., 2001;Haciseferogullari*et al*., 2007;*et al*., 2007; Munzoruglu *et al*., 2003; Gurrieri *et al*., 2001.

Table 3: Phytochemical composition of apricot

Compounds	Concentration (mg/100g FW)	Compounds	Concentration (mg/100g FW)
Total phenolics (GAE)	50.00-563.00	Kaempferol 3-rutinoside	0.00-1.12
Total carotenoids (β-carot. E.)	2.00-20.77	Procyanidins	32.00-333.10
Phenolic acids		Flavonols	37.00-147.00
Chlorogenic acid	2.80	**Carotenoids**	
Caffeic acid	0.81	β-carotene	0.26-14.17
p-Coumaric acid	1.12	γ-carotene	0.00-1.11
Ferulic acid	0.30	β-cryptoxanthin	0.000-1.07
Cinnamic acid	6.00-110.00	Phytofluene	0.00-4.70
Flavonoids		Phytoene	0.40-5.96
(+)-Catechin	3.82	Lutein	0.00-0.10
(-)-Epicatechin	4.19	Zeaxanthin	0.00-0.03
Quercetin 3-rutinoside	2.15		

GAE = Gallic acid equivalents, β-carot. E = β-caroteneequivalent, FW = Data presented on fresh weight basis
Sources: Lecesse *et al*., 2007; Chauhan *et al*., 2001;Akin *et al*., 2007; Munzoruglu *et al*., 2003;Gurrieri *et al*., 2001; Dragovic-Uzelac *et al*., 2007; Sochor *et al*., 2010;Kalyoncu *et al*., 2009; De Rigal*et al*., 2000; Ruiz *et al*., 2008; Khachik *et al*., 1989.

Table 4: Antioxidant capacity of apricot

Assay System	Antioxidant Capacity	References
TEA_{CUPRAC} (µmolTrolox/100g FW)	2.67-4.23	Gucluet *al*., 2006
$TEAC_{ABTS}$ (µmolTrolox/100g FW)	2.86-4.46	Gucluet *al*., 2006; Lecesse*et al*., 2007
$TEAC_{F\text{-}C}$ (µmolTrolox/100g FW)	8.47-11.38	Gucluet *al*., 2006
$TEAC_{DPPH}$ (mg Trolox/100g FW)	8.00-556.00	Drogoudiet *al*., 2008
$TEAC_{FRAP}$ (mg Trolox/100g FW)	12.00-103.00	Sochoret *al*., 2010
DPPH IC_{50} (mg/ml)	9.60-59.47	Kalyoncuet *al*., 2009
AEAC (mg AE /100g FW)	34.17	Lecesse*et al*., 2007; Drogoudi*et al*., 2008

TEAC= Trolox equivalent antioxidant capacity, CUPRC= Cupric ion reducing antioxidant capacity, ABTS= 2, 2-azinobis (3-ethylbenzothiazoline-6-sulphonic acid), F-C= Folin-Cioculteu reagent, DPPH= 1, 1-diphenyl-2 picrylhydrazyl free radicals, FRAP= Ferric reducing antioxidant power, AEAC= Ascorbate equivalent antioxidant capacity, FW= Data presented on fresh weight basis

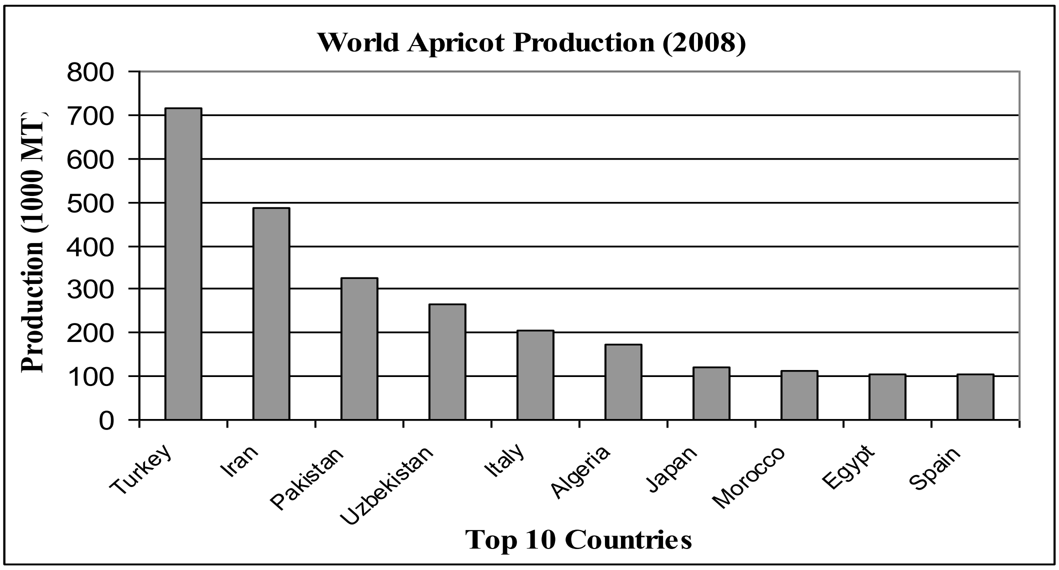

Fig. 1. World apricot production (FAO Stat. 2010)

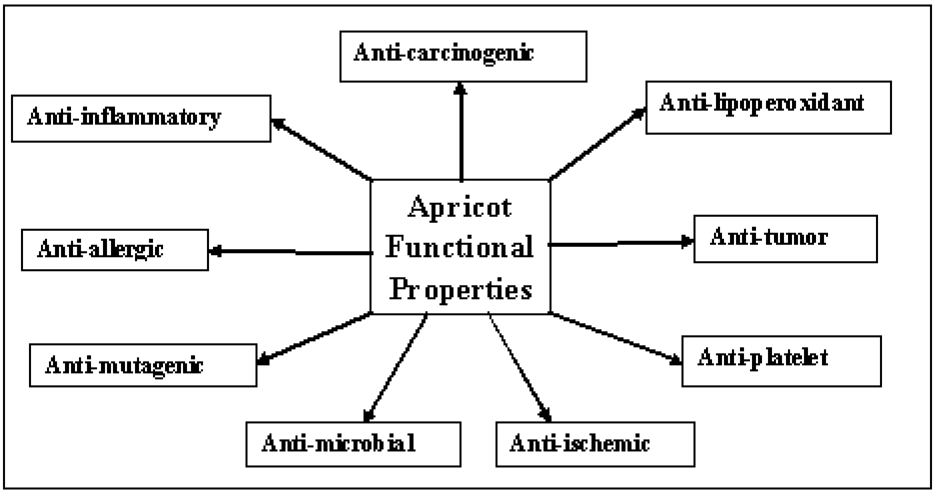

Fig. 2: Functional properties of apricot
Sources; De Rigal*et al.*, 2000; Pramer and Kaushal, 1982;Lule and Xia, 2005.

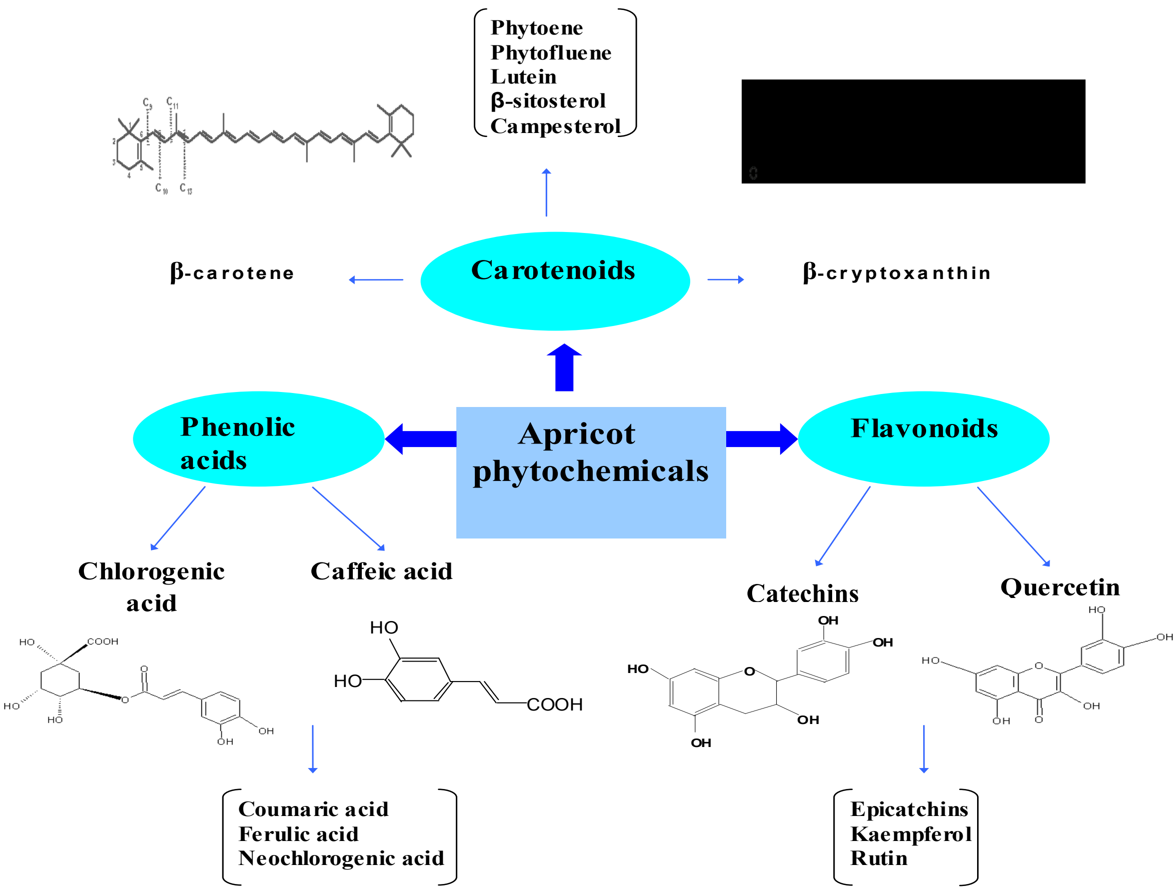

Fig. 3. Important phytochemicals of apricot

Sources; Akbulut and Artik, 2002; Sochor*et al.*, 2010; Kalyoncu*et al.*, 2009; Radi*et al.*, 1997; Miguel *et al.*, 2008; Garcia-Viguera*et al.*, 1994; Ruiz*et al.*, 2005.

3. 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 like polyphenols, carotenoids and vitamins. These substances have crucial roles in disease prevention and health maintenance. The effectiveness of apricot against stomach inflammations, hepatic disorder, tumor formation and chronic heart disease prove it as a functional food. However, the available information is not much more disease specific except some studies. Therefore the persisting need is to conduct systematic and in depth biological studies to explore the potential health benefits of the fruit to frame a strong logical conclusion. 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.

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