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REVIEW ARTICLE

A Review on Phytochemical and Pharmacological Studies of Fruit *Prunus armeniaca* Linn.

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ABSTRACT

Apricot (*Prunus armeniaca* Linn.) fruit is good for human health and plays a very important role in our body. Literature studies revealed that apricot fruit has various biological activities such as antioxidant, antibacterial, antimicrobial, anti-inflammatory, and immune-stimulating functions that can be attributed to the content of many phenolic compounds. Apricot fruit contains various phytochemicals such as flavonoids, polyphenols, carotenoids, and phenolic acids by which there are changes in taste, color, and nutritional value of the fruit. The pharmacological studies show that it has anticancer activity which can be validated by clinical trials.

Keywords: Apricot (*Prunus armeniaca* Linn.), fruit, phytochemical and pharmacological studies

INTRODUCTION

Apricot is botanically known as *Prunus armeniaca* Linn. in Latin word it is known as "precocious" or "early ripening. It is also called as Khubani belongs to family Rosaceae, subfamily – Rosidae and order – Rosales." In Eastern countries, the apricot is also known as "moon of the faithful" and the ancient Persians referred it as "Egg of the sun"[1] *P. armeniaca* Linn. is a virtuous source of nutrients and one of the most familiar crops worldwide.[2] Wild apricot belongs to the family *Rosaceae* and subfamily *Prunoidea*.[3] Some common species are *Prunus dulcis* (Almond), *Prunus domestica* (plum), *Prunus cerasus* (sour cherry), *Prunus pumila* (sand cherry), *Prunus padus* (European bird cherry), *Prunus laurocerasus* (European cherry-laurel), and *P. armeniaca* (apricot). It is a moderate-sized tree, about 10 m tall with reddish bark.[4] Cultivation of apricots is near about 600 hectares in Kashmir, 375 hectares in Himachal Pradesh, and 1600 hectares in Kumaun region (Uttarakhand). Varieties of apricot nearby found in India are "Halman and Rakchaikarpo" which are reported in Leh Ladakh area of Jammu and Kashmir state.[5] Turkey is one of the major apricot producers in the world with an approximate annual yield of 538,000, 35,000, and 7000 tonnes/year fresh fruit, seed, and kernel, half of this amount comes from Malatya region located in Eastern part of the country.[6]

This type of fruit is a nurture type of Zerdali (wild apricot) which is produced by inoculation. Apricot plays an important role in human nutrition and can be used as fresh, dried, or processed fruit.[7] Apricot grows in temperate and subtropical regions worldwide and is the third economically most important stone fruit that is peach and plum.[8] It is mostly grown and cultivated in the Mediterranean countries, Central Asia, Russia, United States of America, Iran, Iraq, Afghanistan, Pakistan, Syria and Turkey, Northwest Hills Region (Jammu and Kashmir and Himachal Pradesh), North Eastern Hills Region (Arunachal Pradesh, Meghalaya, Nagaland, Sikkim, and Manipur), and also Uttar Pradesh. About 90% of the overall production of apricot comes from the USA.[9] The total world

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production of apricot is around 2.6 million tonnes. The fruit pulp of apricot is so thin and dry that its mature pulp is so easy to discrete. Pulp of apricot fruit is indigestible due to its acidic nature. The dietary fiber content of apricot pulp is more than 50%. Water-soluble dietary fiber contains polysaccharides, which are known to have good biological activities.[10]

Apricot is temperate fruits which are grown in climates with well-differentiated seasons. Mechanisms against low wintertime temperatures and cold damage have been developed by species growing under these conditions. Dormancy and freezing tolerance are the main mechanisms that are developed against these difficulties and although they can be independent,[11] freezing tolerance cannot be developed adequately without growing cessation,[12] which marks the onset of dormancy.

The fruit of apricot is not only consumed fresh but also used to produce dried apricot, frozen apricot, jam, jelly, marmalade, pulp, juice, nectar, and extraction products. Furthermore, apricot kernels are used in the production of oils, benzaldehyde, cosmetics, active carbon, and aroma perfume.[13]

Iran is the second apricot producer worldwide with 275,580 ton production and 8.2% share.[14] The cultivation of apricot needs extensive strength and energy. In Iran, apricot fruits are harvested at about 77% moisture level.[15]

Apricot is also used in protective effect of dietary apricot kernel oil supplementation on cholesterol levels and antioxidant level of liver in hypercholesteremic rats.[16]

The matters of unsaturated fatty acids (91.5–91.8%), saturated fatty acids (7.2–8.3%), neutral lipids (95.7–95.2%), glycolipids (1.3–1.8%), and phospholipids (2.0%) of apricot oil have been reported.[16,17]

In organisms, endogenous, and exogenous free radicals can damage lipids, proteins, carbohydrates, and nucleic acids which themselves turn out as new free radicals.[18,19] In all the biomolecules, lipids are the highest sensitive molecules to attack free radical. Double bonds in fatty acids form peroxide products by react with free radicals and lipid radicals can be formed afterward on removal of electrons.[20,21]

By lipid peroxidation, injurious degradative products which are called as malondialdehyde (MDA), can be formed in cell membranes. MDA shows both mutagenic and carcinogenic effects by altering membrane properties.[22,23] Apricot is a good dietary source of protein, oil, fiber, phenolic, and cyanogenic compounds.[24-26] Oleic acid and linoleic acid are the main components of pectin, polysaccharides, cellulose, and hemicellulose are the main polysaccharides.[27] Apricot has been conventionally used in gastric inflammation, dermatitis and also as a carminative agent. The oil is used as laxative and medicine for otitis and tinnitus in drop dosage form.[28,29]

Pharmacologic studies have also shown antioxidant and radical scavenging properties, antimicrobial activity, and antitussive effects for apricot. As above-mentioned activities, this study shows two main fractions of apricot, including extract and extract oil, could exert anticolitis effects in rat model of experimental colitis.[30-32]

Phytochemistry of apricot

The apricot fruits are rich source of oil, protein, soluble sugars, fiber as well as fatty acids, carotenoids such as β-carotene, β-cryptoxanthin, γ-carotene, and lycopene, phenolics such as chlorogenic and neochlorogenic acids, (+)-catechin and (−)-epicatechin, and rutin, and pectin and mineral essentials including Na, P, K, Ca, Mg, Fe, Zn, Mn, and Cu.[33-35]

The phytochemicals present in apricot are monosaccharides[36] and polysaccharides,[37] carotenoids,[38] fatty acids[39] and sterol derivatives,[40] volatile components,[41] polyphenols,[42] and cyanogenic glucosides.[43]

Biological activities of apricot

The various biological activities of apricot are antimicrobial activity,[9,44] antimutagenic activity,[44] enzyme inhibitory activity,[9] cardioprotective activity,[45] hepatoprotective activity,[46] anti-inflammatory activity,[47,48] antinociceptive activity,[49] and antioxidant activity.[50] New flavonoid derivatives are isolated from butanol extract of *P. armeniaca* which shows antimicrobial activity.[51] Methanol extracts of

the plant show antimicrobial activity against Gram-negative bacteria.[52] Apricot shows ameliorative and preventive effect on oxidative damage.[53]

Morphology of *P. armeniaca*

It is a small to medium sized tree with a dense having spreading canopy which is 8–12 m tall. Its leaves are about 0 cm long 3–4 cm wide and are heart shaped with pointed tips. The fruit is yellow to orange in color and sometimes with a red cast; its surface is smooth and hairless.[54]

TAXONOMY OF *P. ARMENIACA*

Classification of family Rosaceae[55]

Kingdom	Plantae
Subkingdom	Tracheobionta
Super division	Spermatophyta
Division	Magnoliophyta
Class	Magnoliopsida
Subclass	Rosidae
Order	Rosales
Family	Rosaceae

Scientific classification

Kingdom	Plantae
Order	Rosales
Family	Rosaceae
Genus	*Prunus*
Species	*Prunus armeniaca*

Uses

- Apricot is used as an antidote or an anthelmintic and an expectorant. Apricot is used for cough, it is effective against constipation, asthma, bleeding, infertility, and eye inflammation.[56]
- Apricot is used to reduce cholesterol levels, deterioration of vision, weight loss, treat respiratory conditions, and maintain electrolyte balance in the body. Apricot is also used to improve heart health and treat strained muscles and wounds. Apricot also shows strong antioxidant activity due to the presence of 50% of recommended intake of beta-carotene.[57]
- Free radicals may lie at the heart of the etiology or of the natural history of the amount of diseases, including cancer and atherosclerosis.[58-60]
- Fruits and vegetables contain many dissimilar antioxidant components. For example, some flavonoids (including flavones, isoflavones, flavonones, anthocyanins, catechin, and isocatechin) that are frequent components of the human diet have demonstrated strong antioxidant activities.[61]
- In fact, higher plants exhibit significant potency against human bacterial and fungal pathogens. Apart from being the primary food source of some important nutrients, fruits, and vegetables also contain a variety of bioactive components, which might have other beneficial health effects.[62]
- Apricot kernels contain a substantial amount of dietary protein, with significant amounts of oil and fiber.[63] Sweet apricot contains more oil than bitter kernels, and that oleic acid and linoleic acid correspond to approximately 92/100 g of the total fatty acids.[64]
- Apricot distils can improve colon inflammation and ulcers excited by trinitrobenzene sulfonic acid.[63]
- The different parts of the plant are used in traditional medicine for the treatment of a variety of common diseases such as cough, asthma, bronchitis, anemia, and fever.[65]
- Apricot is used as food additives.[66]
- Apricot also possesses antioxidant, anti-asthmatic, antitussive, and antispasmodic activity.[67]

TRADITIONAL USES

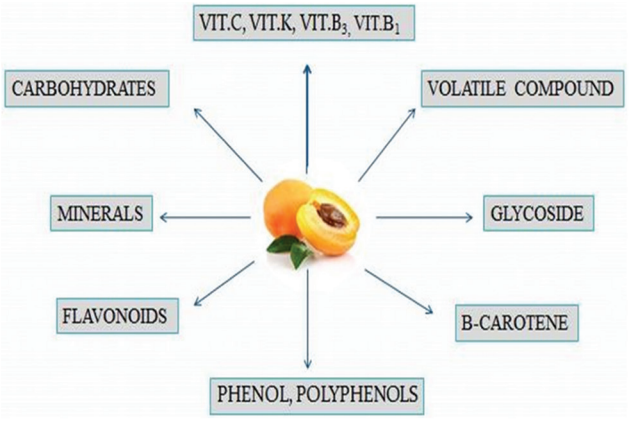
Conventionally, apricot is used for the treatment of fever, cough, cold, bronchitis, laryngitis, hemorrhages, anemia, and certain tumors. It is reported that fruits are used to increase fertility. *P. domestica* fruits are used to treat jaundice and hepatitis and its gum is also used as a tonic and laxative.[68] Apricot kernels, depending on the variety, contain the toxic cyanogenic glycoside amygdalin.[69] Amygdalin can be hydrolyzed to produce glucose, benzaldehyde, and hydrocyanic acid. Enzymatic release of cyanide occurs in the

presence of β-glucuronidase, an enzyme found in the human intestine.[27]

CHEMISTRY OF APRICOT

Apricot is rich in organic acids, monosaccharides, polysaccharides, polyphenols, fatty acids, and sterols and its derivatives, carotenoids, metals, minerals, and volatile components. The flavonoids are one of the most numerous and widespread groups of natural products, they contribute color to plants and many of them are physiologically active compounds known for their antioxidant activities.[70] It has been conveyed that dry matter, sugar (as the major sugars sucrose, glucose, and fructose), and sorbitol content of Malatya apricot kinds are importantly higher than others. Malatya apricots were found to be a rich source of phenolic compounds and malic acid as the heavy organic acid. They emphasized that the K content of Malatya apricots was considerable high and these apricots were major sources of Mg, Zn, and Se.[71] In another study, the elements existing in seed oil were detected and apricot is rich in P, Ca, Mg, Fe, and Cu, and seed oil also comprised oleic acid (73.58%), linoleic acid (19.26%), palmitic acid (3.31%), and myristic acid (1.18%).[35]

CHEMICAL CONSTITUENTS



Fruit polysaccharides whole solids (12.4–16.7%), unsolvable solids (2.1–3.1%), acids as malic acid (0.7–2.2%), total sugar as invert sugar (5.3–8.6%), glucose (3.2–4.8%), fructose (1.4–4.25 %), sucrose (1.4–5.4%), and tannins (0.06–0.0%), Flavonoids are divided into eight subgroups: Chalcone, flavone, flavonone, flavanol, flavanolol, anthocyanins, proanthocyanidins, and isoflavonoids.[72] Sugar, organic acid, vitamins, phenolic compounds, and carotenoids are being natural components of fruits, and apricot plays important role in maintaining fruit quality and nutritive value.[73] The flavonoids contain one of the most numerous and widespread groups of natural products and are important to human because they contribute color to plants and many of them are physiologically active compound and known for their antioxidant activities.[74] All flavonoid compounds are obtained from either 2-phenylbenzopyrone or 3-phenylbenzopyrone moiety. Flavonoids are subdivided into eight subgroups that are chalcone, flavone, flavonol, flavanone, flavanolol, anthocyanins, proanthocyanidins, and isoflavonoids.[75]

NUTRITIONAL ANALYSIS

In the nutritional analysis of the dried apricot shows a good potential health benefits. Ash content and moisture of fruit play an important role in affecting the nutritional composition of the fruit. The moisture content of the food affects the appearance, texture, and its storage ability in case of dry fruits. Low-fat content is observed in the sample that is 0.006% which signifies it as a good and found to be healthy fruit. Low in fat which describes that it has low calories which will avoid obesity. The existence of protein will serve as building block of cells, muscles, cartilage, skin, hormones, enzymes, vitamins.[76]

PHYTOCHEMICAL ANALYSIS OF DRY APRICOT

Apricot contains phenolic compounds that are phenolic acids and flavonoids, and total phenolic composition is in the range of 500.0–563.0 mg GAE/100 g on fresh weight basis. Apricot fruit contains many essential amino acids; apricot seed contains important levels of dietary protein and significant amounts of oil and fiber. Phytochemicals are known to be the main bioactive compounds which have many health benefits. In food industries, they are very interested in using the plant extracts for having good total phenolic content.[77]

CHROMATOGRAPHIC TECHNIQUES OF *P. ARMENIACA*

High-performance liquid chromatography (HPLC) techniques

Apricot (*P. armeniaca* Linn.) var. Canino was separated and measured by HPLC. The mobile phase was attuned at an optimum pH of 2.15. The absorbance is at 210 nm which is measured with a diode array ultraviolet (UV) detector used for quantification. The method is quantitative, with recoveries in the range 95.7–103.5%. Organic acids in apricot were separated and measured by HPLC with satisfactory repeatability. Oxalic, galacturonic, tartaric, quinic, malic, shikimic, and citric acids have been determined simultaneously and eluted within 60 min. Considering how little sample preparation is required, the proposed procedure can be considered to be a precise and rapid method for organic acids determination.[78]

SPECTROSCOPIC TECHNIQUES

UV spectroscopy of apricot

Gold (Au) and silver (Ag) nanoparticles of apricot were biosynthesized using the gum extract of *P. armeniaca* Linn. These were characterized by UV-visible spectroscopy, Fourier-transform infrared spectroscopy, X-ray diffusion, and atomic absorption. Formation of Ag was confirmed from the surface plasmon resonance center at 555 and 450 nm which are calculated from the results of Fourier-transform infrared spectroscopy, X-ray diffraction, and atomic absorption spectroscopy whereas scanning electron microscope analysis shows that Au was spherical in size and in range of 5–40 nm.[79]

Nuclear magnetic resonance (NMR) spectroscopy of apricot

The chemical composition of apricot pit shells before and after hot water extraction was analyzed by $_1$H-NMR. Apricot chemical composition was estimated before and after by 1HNMR / standard methods of hot water extract or extract of apricot pit shell which showed near about 77% of xylan in raw apricot and also 24 % lignin.[80,81]

PHARMACOLOGICAL ANALYSIS

Literature reveals its various activities such as antimicrobial, cardioprotective, antinociceptive, antioxidant, anticarcinogenic, antiaggregant, antiischemic, antiallergic, antimutagenic, and anti-inflammatory as well as effective in alleviating cardiovascular diseases.[63]

Antimicrobial activity

Both nasty and sweet kernel of *P. armeniaca* Linn. showed antibacterial activity against Gram-positive bacteria *Staphylococcus aureus* and Gram-negative bacteria *Escherichia coli* and showed antifungal activity against *Candida albicans* and *Candida glabrata*.[82] The fruit illustrates maximum inhibitory activity against *Micrococcus luteus*;[83] however, there is no antimicrobial activity that has been reported from essential oil of apricots.[84]

Antioxidant activity

The maximum of the phenolic compounds was determined by measuring absorbance of the extract solutions after incubating them with Folin-Ciocalteu reagent occurring in fruits exhibit antioxidant activity. Both water and methanolic extract of fruit show good antioxidant activity.[85,86] The highest phenolic content (7.9 ± 0.2 μg/mL) and lowest phenolic content (0.4 ± 0.1 μg/mL) was detected in water extract of sweet apricot and bitter apricot. The methanolic extract of leaf also shows good antioxidant activity when determined by enzyme analysis, pigment analysis, and protein extraction parameters.[87]

Anticancer activity

Due to the presence of cyanogenic glycosides in seeds, it is reported to be used as a medicament for the treatment of cancer.[88] It is used as an alternative treatment for cancer has also been extracted from apricot seeds. In England, apricot oil is used against tumors, swellings, and ulcers.[89,90]

It has also been revealed by scientists in the Republic of Korea in 2005 that treating human prostate cancer cells with amygdalin induces programmed cell death.[91,92] Apricots are rich in antioxidants. The carotenoids and antioxidants shield our body from the dangerous free radicals and prevent the damage of cells. Apricot is also rich in Vitamins A and C which is powerful antioxidants used to fight cancer diseases and boost the immune system. Moreover, apricot seeds contain a compound called B17 that can fight cancer and curb its mutative ability.[93,94]

Hepatoprotective activity

Liver protective herbal drugs contain a variety of chemical constituents such as phenols, lignans, coumarins, essential oil, monoterpenes, glycosides, carotenoids, flavonoids, alkaloids, lipids, and xanthines. Extract of about 25 different plants has been reported to treat liver disorders. In Ayurveda about 77 herbal drugs have been used as a hepatoprotective agent. Excessive drug therapy, hepatic cancer, environmental pollutants, and alcoholic intoxicants are the main causes of liver disorders. In India, over 40 polyherbal commercial formulations listed to have hepatoprotective action. The study of literature indicates that 160 phytoconstituents from 101 plant families have anti-hepatotoxic activity.[95]

CONCLUSION

The work gives an overview of antioxidant, anticancer, antimicrobial, and other activities. The apricot fruit is used for reducing cholesterol levels and weight loss. The apricot fruit is safe, effective, and beneficial for our health. In the chemical composition of apricot contains 50% of beta-carotene due to this, it shows strong antioxidant activity.

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AUTHORS' CONTRIBUTION

We declare that this work was done by the authors named in this article and all liabilities pertaining to claims relating to the content of this article will be borne by the authors. Mr. Deepak Shrivastav collected the data and analyzed the data and prepared the manuscript. Dr. Suman Lata read the whole manuscript, and suggested the necessary changes, and helps in designing the manuscript.

CONFLICTS OF INTEREST

The authors declared that they have no conflicts of interest.

REFERENCES

1. Varsha R, Jain A, Chaudhary J. *Prunus armeniaca* (Apricot): An overview. Int J Pharm Pharm Sci 2012;5:3964-6.
2. Baytop T. Türkiyede Bitkilerle Tedavi. Istanbul: Istanbul Eczacilik Fakültesi Yayinlari; 1999.
3. Chopra RN, Nayar L, Chopra IC. Glossary of Indian Medicinal Plants. New Delhi: Council of Scientific and Industrial Research; 1956. p. 204.
4. Krishnamurty A. The Wealth of India: Raw Materials. New Delhi: Publications and Information Directorate, Council of Scientific and Industrial Research; 1969. p. 256-61.
5. Dang RL, Narayanan R, Rao PS. Kumaon apricot kernel oil: Its composition and utilization. Ind Oil Seeds J 1964;8:110-5.
6. Gezer Y, Dikilitas S. The study of work process and determination of some working parameters in an apricot pit processing plant in Turkey. J Food Eng 2002;53:111-4.
7. Ozbek S. Special Horticulture. C. U. Faculty of Agriculture No. 128, Adana, Turkey.
8. Cui J, Gu X, Wang F, Ouyang J, Wang J. Purification and structural characterization of an α-glucosidase inhibitory polysaccharide from apricot (*Armeniaca sibirica* L. Lam.) Pulp. Carbohydr Polym 2015;121:9-314.
9. Yiğit D, Yiğit N, Mavi A. Antioxidant and antimicrobial activities of bitter and sweet apricot (*Prunus armeniaca* L.) kernels. Braz J Med Biol Res 2009;42:346-52.
10. Maghuly F, Borroto E, Ruthner S, Pedrye A, Laimer M. Microsatellite variability in apricots (*Prunus armeniaca* L.) reflects their geographic origin and

breeding history. Tree Genet Genomes 2005;1:151-65.
11. Irving RM, Lamphear FO. Environmental control of cold hardiness in woody plants. J Plant Physiol 1967;42:1191-6.
12. Fuchigami LH, Weiser CJ, Evert DR. Induction of cold acclimation in *Cornus stolonifera* Michx. J Plant Physiol 1971a;47:98-103.
13. Yildiz F. New technologies in apricot processing. J Stand 1994;1:67-9.
14. Davidson A. The Oxford Companion to Food. 2nd ed. Oxford: Oxford University Press; 2006.
15. Ministry of Jihad-e-Agriculture. Agricultural Statistical Bulletin (ASB), Crop Year 2005-2006. Iran: Ministry of Jihad-e-Agriculture; 2006.
16. Alpaslan M, Hayta M. Apricot kernel: Physical and chemical properties. J Am Oil Chem Soc 2006;83:469-71.
17. Turan S, Topcu A, Karabulut I, Vural H, Hayaloglu AA. Fatty acid, triacylglycerol, phytosterol, and tocopherol variations in kernel oil of malatya apricots from Turkey. J Agric Food Chem 2007;55:10787-94.
18. Bast A, Haenen M, Cees J, Doelwan A. Oxidants andantioxidants: State of the art. Am J Med 1991;91:2-10.
19. Matés JM, Pérez-Gómez C, Núñez de Castro I. Antioxidant enzymes and human diseases. Clin Biochem 1999;32:595-603.
20. Cheeseman KH. Mechanisms and effects of lipid peroxidation. Mol Aspects Med 1993;14:191-7.
21. Girotti AW. Lipid hydroperoxide generation, turnover, and effector action in biological systems. J Lipid Res 1998;39:1529-42.
22. Nielsen F, Mikkelsen B, Nielsen J, Andersen HR, Grandjean P. Plasma malondialdehyde as biomarker for oxidative stress: Reference interval and effects of life-style factors. Clin Chem 1997;3:1204-14.
23. Gebhardt R. Oxidative stress, plant-derived antioxidants and liver fibrosis. Planta Med 2002;68:289-96.
24. Gokhandurmaz MA. Antioxidant properties of roasted apricot *Prunus armeniaca* L kernel. Food Chem 2007;100:1177-81.
25. El-Aal MH, Hamza MA, Rahma EH. Chemical characterization of peach kernel oil and protein: Functional properties, in vitro digestibility and amino acids profile of the flour. Food Chem 1986;19:287-9.
26. Sefer F, Misirli A, Gulcan R. Investigations on fertilization biology of important dried apricot cultivars. Int Soc Hortic Sci Acta Horticult 2006;701:167-70.
27. Femenia A, Rosello C, Mulet A, Canellas J. Chemical composition of bitter and sweet apricot kernels. J Agric Food Chem 1995;43:356-61.
28. World Health Organization. WHO Monographs on Selected Medicinal Plants. Geneva: World Health Organization Publications; 2007.
29. Tonekaboni SM. Tohfatalmomenin. Tehran: Publications of Traditional Medicine Research Center of Shahid Beheshti University of Medical Sciences; 2006.
30. Miyagoshi M, Amagaya S, Ogihara Y. Antitussive effects of L-ephedrine, amygdalin, and makyokansekito (Chinese traditional medicine) using a cough model induced by sulfur dioxide gas in mice. Planta Med 1986;4:275-8.
31. Waterhouse AL. Determination of Total Phenolics. 3rd ed. New York: John Wiley; 2001.
32. Iranian Ministry of Health Publications. Iranian Herbal Pharmacopoeia Committee, Iranian Herbal Pharmacopoeia. 1st ed. Tehran: Iranian Ministry of Health Publications; 2002.
33. Dwivedi DH, Ram RB. Chemical composition of bitter apricot kernels from Ladakh, India. Int Soc. for Hortic Sci Acta Horticult 765:335-8.
34. Orhan I, Koca U, Aslan S, Kartal M, Küsmenoglu S. Fatty acid analysis of some Turkish apricot seed oils by GC and GC-MS techniques. Turk J Pharm Sci 2008;5:29-34.
35. Akin EB, Karabulut I, Topcu A. Some compositional properties of main Malatya apricot (*Prunus armeniaca* L.) varieties. Food Chem 2008;107:939-48.
36. Bassi D, Bartolozzi F, Muzzi E. Patterns and heritability of carboxylic acids and soluble sugars in fruits of apricot (*Prunus armeniaca* L.). Plant Breed 1996;115:67-70.
37. Kurz C, Carle R, Schieber A. HPLC-DAD-MS(n) characterisation of carotenoids from apricots and pumpkins for the evaluation of fruit product authenticity. Food Chem 2008;110:522-30.
38. Ruiz D, Egea J, Gil MI, Tomás-Barberán FA. Characterization and quantitation of phenolic compounds in new apricot (*Prunus armeniaca* L.) varieties. J Agric Food Chem 2005;53:9544-52.
39. Ul'chenko NT, Bekker NP, Yunusov O, Yuldasheva NK, Chernenko TV Glushenkova AI. Lipids and lipophilic components from seeds of some fruit plants. Chem Nat Compd 2009;45:314-7.
40. Mandal S, Suneja P, Malik SK, Mishra SK. Variability in kernel oil, its fatty acid and protein contents of different apricot (*Prunus armeniaca*) genotypes. Indian J Agric Sci 2007;77:464-6.
41. Takeoka GR, Flath RA, Mon TR, Teranishi R, Guentert M. Volatile constituents of apricot (*Prunus armeniaca*). J Agric Food Chem 1990;38:471-7.
42. Henning W, Herrmann K. Zeitschrift für Lebensmittel-Untersuchung und-Forschung. Vol. 171. Berlin: Springer; 1980. p. 183-8.
43. Zöllner H, Giebelmann R. Deutsche Lebensmittel-Rundschau. Vol. 103. Jahrgang, Heft:2; 2007. p. 71-7.
44. Rashid F, Ahmed R, Mahmood A, Ahmad Z, Bibi N, Kazmi SU, *et al.* Flavonoid glycosides from *Prunus armeniaca* and the antibacterial activity of a crude extract. Arch Pharm Res 2007;30:932-7.
45. Ugras MY, Kurus M, Ates B, Soylemez H, Otlu A, Yilmaz I, *et al. Prunus armeniaca* L (apricot) protects rat testes from detrimental effects of low-dose x-rays. Nutr Res 2010;30:200-8.
46. Yamamoto K, Osaki Y, Kato T, Miyazaki T. Antimutagenic substances in the armeniacae semen and persicae semen. Yakugaku Zasshi 1992;112:934-9.
47. Matsuda H, Nakamura S, Kubo M. Studies of cuticle

drugs from natural sources. II. Inhibitory effects of prunus plants on melanin biosynthesis. Biol Pharm Bull 1994;17:1417-20.
48. Parlakpinar H, Olmez E, Acet A, Ozturk F, Tasdemir S, Ates B, *et al.* Beneficial effects of apricot-feeding on myocardial ischemia-reperfusion injury in rats. Food Chem Toxicol 2009;47:802-8.
49. Ozturk F, Gul M, Ates B, Ozturk IC, Cetin A, Vardi N, *et al.* Protective effect of apricot (*Prunus armeniaca* L.) on hepatic steatosis and damage induced by carbon tetrachloride in wistar rats. Br J Nutr 2009;102:1767-75.
50. Chang HK, Yang HY, Lee TH, Shin MC, Lee MH, Shin MS, *et al.* Armeniacae semen extract suppresses lipopolysaccharide-induced expressions of cyclooxygenase [correction of cycloosygenase]-2 and inducible nitric oxide synthase in mouse BV2 microglial cells. Biol Pharm Bull 2005;28:449-54.
51. Lee HJ, Ryu JH. Screening of leukotriene B4 receptor antagonist activity from the herbal drugs. Kor J Pharmacogn 2000;31:273-9.
52. Hwang HJ, Kim P, Kim CJ, Lee HJ, Shim I, Yin CS, *et al.* Antinociceptive effect of amygdalin isolated from prunus armeniaca on formalin-induced pain in rats. Biol Pharm Bull 2008;31:1559-64.
53. Ishiwaba K, Yamaguchi T, Takamura H, Matoba T. DPPH radical-scavenging activity and polyphenol content in dried fruits. Food Sci Technol Res 2004;10:152-6.
54. Mir AK, Waqar A, Salimullah K. Formulation and evaluation of sustained release tablets using *Prunus armeniaca* (L.) and *Prunus domestica* (L.) gums. Iran J Pharm Sci Autumn 2012;8:233-40.
55. Ames BN. Dietary carcinogens and anticarcinogens. Oxygen radicals and degenerative diseases. Science 1983;221:1256-64.
56. Ness AR, Powles JW. Fruit and vegetables, and cardiovascular disease: A review. Int J Epidemiol 1997;26:1-3.
57. Poulsen HE, Prieme H, Loft S. Role of oxidative DNA damage in cancer initiation and promotion. Eur J Cancer Prev 1998;7:9-16.
58. Kris-Etherton PM, Hecker KD, Bonanome A, Coval SM, Binkoski AE, Hilpert KF, *et al.* Bioactive compounds in foods: Their role in the prevention of cardiovascular disease and cancer. Am J Med 2002;113 Suppl 9B:71S-88S.
59. Cos P, Vlietinck AJ, Berghe DV, Maes L. Anti-infective potential of natural products: How to develop a stronger *in vitro* 'proof-of-concept'. J Ethnopharmacol 2006;106:290-302.
60. Ruiz D, Egea J, Gil MI, Tomas-Barberan FA. Phytonutrient content in new apricot (*Prunus armeniaca* L.) varieties. Int Soc Hortic Sci Acta Horticult 2006;717:363-5.
61. Riu-Aumatell M, Lopez-Tamames E, Buxaderas S. Characterization of volatiles in different dry gins. J Agric Food Chem 2005;53:7837-43.
62. Ruiz D, Egea J, Tomás-Barberán FA, Gil MI. Carotenoids from new apricot (*Prunus armeniaca* L.) varieties and their relationship with flesh and skin color. J Agric Food Chem 2005;53:6368-74.
63. Erdogan-Orhana I, Kartal M. Insights into research on phytochemistry and biological activites of *Prunus armeniaca* L. apricot). Food Res Int 2011;44:1238-43.
64. Asma BM, Kan T, Birhanli O. Characterization of promising apricot (*Prunus armeniaca* L.)genetic resources in Malatya, Turkey. Gen Res Crop Evo 2007;54:205-12.
65. Sefer F, Misirli A, Gülcan R. A research on phenolic and cyanogenic compounds in sweet and bitter kernelled apricot varieties. Int Soc Hortic Sci Acta Horticult 2006;701:167-9.
66. Nout MJ, Tunçel G, Brimer L. Microbial degradation of amygdalin of bitter apricot seeds (*Prunus armeniaca*). Int J Food Microbiol 1995;24:407-12.
67. El-Aal MH, Hamza MA, Rahma EH. Apricot kernel oil: Characterization, chemical composition and utilization in some baked products. Food Chem 1986;19:287-98.
68. Haciseferoğullari H, Gezer I, Özcan MM, Asma BM. Post-harvest chemical and physical mechanical properties of some apricot varieties cultivated in Turkey. J Food Eng 2007;78:364-73.
69. Miguel G, Dandlen S, Neves and Antunes D. 4th IASME/WSEAS International Conference on Energy, Environment, Ecosystems and Sustainable Development (EEESD'08); 2008.
70. Sharma S, Satpathy G, Gupta R. Nutritional, phytochemical, antioxidant and antimicrobial activity of Prunus armenicus. J Pharmacogn Phytochem 2014;3:23-8.
71. Gilani SA, Qureshi RA, Khan AM, Potter D. A molecular phylogeny of selected species of genus *Prunus* L. (Rosaceae) from Pakistan using the internal transcribed spacer (ITS) spacer DNA. Afr J Biotech 2010;9:2872-9.
72. Bachheti RK, Rai I, Joshi A, Rana V. Physico-chemical study of seed oil of *Prunus armeniaca* L. grown in Garhwal region (India) and its comparison with some conventional food oils Int Food Res J 2012;19:577-81.
73. Ghasemhezhad M, Shiri MA, Sanavi M. Effect of chitosan coating on some quality indices of apricot (*Prunus armeniaca* L.) during cold storage, Caspian J Environ Sci 2010;8:25-33.
74. Amoros A, Serrano M, Riquelme F, Romojaro F. Effect of chlorine dioxide on ripening of Xiaobai apricot. Fruits 1989;44:171-5.
75. Egea MI, Martinez-Madrid MC, Sanchez-Bel P, Romojaro FM. The influence of electron –beam ionization on ethylene metabolism and quality parameters in apricot (*Prunus armeniacaL.*). Food Sci Technol Int 2007;40:1027-35.
76. Guelfat-Rich S, Ben-arie R, Kahan RS, Eisenber E. Effect of gamma radiation on the ripening of apricots after picking. Fruit 1969;24:137-41.
77. Ugur Y, Erdogan S, Yilmaz I, Basgel S. Variation of quantitative composition of phenolic compounds in the apricot (*Prunus armeniaca* L.) leaves during the growth

seasons. J Nat Prod Plant Resour 2018;8:32-8.
78. Sahin S. Cyanide poisoning in children caused by Apricot seeds. Health Med Informat 2011;2:1-2.
79. Orhan Ie, Kartal M. Insight in to research on phytochemistry and biological activites of *Prunus armeniacaL*. (apricot). Food Res Int 2010;44:152.
80. Bilal JM, Louwy MA, Ali K. Study of dried apricot effect on type 2 diabetic patients as a hypoglycemic material. Iraq J Community Med 2012;1:82-7.
81. Corbett DB, Kohan N. Chemical composition of apricot pit shells and effect of hot water extraction. Energies 2015;8:9640-54.
82. Hasib A, Jaouad A, Mahrouz M, Khouili M. HPLC determination of organic acids in Moroccan apricot. Cienc Tecnol Aliment 2002;3:207-11.
83. Kohan N, Machado G. Bujanovic, chemical composition of apricot pit shells and effect of hot-water extraction. Energies 2015;8:9640-54.
84. Viorica M, Socaciu C, Florica R, Florinela F. Identification and quantitative evaluation of amygdalin from apricot, plum and peach oils and kernels. Buletin USAMV-CN. 2006;62:246-53.
85. Abtani H, Ghazavi A, Karimi M, Mollaghasemi S, Mosayebi G. Antimicrobial activities of water and methanol extracts of bitter apricot seeds. J Med Sci 2008;8:433-6.
86. Popa VM, Bele C, Poina MA, Dumbrava D, Raba DN, Jianu C. Evalution of bioactive compounds and of antioxidant properties in some oil obtained from food industry by- product. Rom Biotechn Let 2011;16:6239-41.
87. Durmaz G, Alpaslan M. Antioxidant properties of roasted apricot (*Prunus armeniaca* L.) kernel. Food Chem 2007;100:1177-81.
88. Kalyoncu HI, Akbulut M, Coklar H. Antioxidant capacity, total phenolic and some chemical properties of semi matured apricot cultivation grown in Malatya Turkey. World Appl Sci J 2009;6:519-23.
89. Scebba F, Sebastiani L, Vitalgiano C. Activities of antioxidant enzymes during senescence of *Prunus armeniaca* leaves. Biol Plantarum 2001;44:41-6.
90. Yan J, Tong S, Li S. Preparative isolation and purification of amygdalin from *Prunus armeniaca* L. with high recovery by high-speed countercurrent chromatography. J Liquid Chromat Related Techno 2006;29:1271-9.
91. Chang HK, Shin MS, Yang HY, Lee JW, Kim YS, Lee MH, *et al.* Amygdalin induces apoptosis through regulation of bax and bcl-2 expressions in human DU145 and LNCaP prostate cancer cells. Biol Pharm Bull 2006;29:1597-602.
92. Akcicek E, Otles S, Esiyok D. Cancer and its prevention by some horticultural and field crops in Turkey. Asian Pac J Cancer Prev 2005;6:224-30.
93. Wei-Feng LV, Ming-Yu D, Rui Z. Isolation and quantitation of amygdalin in apricot-kernel and *Prunus tomentosa* thunb. By HPLC with solid-phase extraction. J Chromatogr Sci 2005;43:383-7.
94. Kshirsagar AD, Mohite R, Aggarwal AS, Suralkar UR. Hepatoprotective medicinal plants of ayurveda. Asian J Pharm Clin Res 2011;4:974-2441.
95. Turkan K, Gokhan D, Burhan A, Ali E. Protective effect of dietary apricot kernel oil supplementation on cholesterol levels and antioxidant status of liver in hypercholesteremic rats. J Food Agric Environ 2009;7:61-5.