

Review

The pharmacological activities of prunes: The dried plums

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Accepted 28 February, 2011

Prunes are dried plums and consumed as food or medicine. *Prunus domestica*, *Prunus salicina* and *Prunus americana* are the important sources of prunes. Prunes are highly reputed in folk medical practices for nutritive, laxative and digestive properties and used for treatment of hypertension, diabetes, jaundice and fever. The recent studies showed that it has antioxidant, anticancer, anti-hyperglycemic, anti-hyperlipidemic, antihypertensive, anti-osteoporosis, laxative and hepatoprotective activities. Prunes contain dietary fibers, carbohydrates, amino acids, vitamins, minerals and antioxidant polyphenolic phytochemicals. Therapeutically active constituents and their possible mechanisms of actions are also been discussed.

Key words: Prunes, antioxidant, anticancer, antihypertensive, antihyperlipidemic, osteoporosis, laxative, anxiolytic.

INTRODUCTION

Prunes are considered as healthy food because of lower fat contents and contain considerable amount of important nutrients like carbohydrates, vitamins and minerals. Prunes and prune products also possess medicinal value. Consumption of fruits, like plums and prunes, is useful in blood circulation problems, measles, digestive problems (Li, 2008), in prevention of cancer, diabetes and obesity. Prunes are high in potassium contents and have beneficial effects in cardiovascular problems. Prunes increase the motility of the gastrointestinal tract and have been found to possess laxative activity. A 100 g serving of prunes fulfill, daily requirement of boron. Prune consumption does not immediately raise blood glucose, therefore, beneficial in diabetes (Stacewicz et al., 2001).

Regular consumption of amygdalin containing fruits was considered to have anticancer action (Ferrel, 1998). Recent studies demonstrated that the cancer preventing actions of prunes are associated with its polyphenolic contents and antioxidant activity, which have inhibitory effects on mutagenesis and carcinogenesis.

BOTANICAL DESCRIPTION

Botanical origin: *Prunus domestica* L. (European Plum), *Prunus salicina* L. (Japanese Plum), *Prunus Americana* Marsh. (American plum, Marshall's large yellow sweet plum)

Family: Rosaceae
English name: Plum
Urdu name: Alu-Bukhara, Alucha
Part used: Fruits (Plum or Prunes)

Fleshy fruits of several species of genus *Prunus*, including that of *P. domestica*, *P. salicina*, *P. americana*, are called Plum. More than 100 species of plum are cultivated in the temperate zones throughout the world since prehistoric times. Commonly, dried plums are called prunes. China is leading plum producing country in the world. Plants are small to medium sized trees. Leaves are ovate or elliptical with acute or obtuse tips, short petioles and crenulate margins. Flowers are small, white and have longer pedicels, mostly born in umbel-like clusters of 2-3 individuals on short spurs, and solitary or 2-3 in axils of 1 year old wood. Fruits are fleshy, oval or round to conical having glaucous surface. Fruits come in variety of colors and sizes.

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NUTRITIONAL AND PHYTOCHEMICAL STUDIES

Prunes are significant source of major nutrients, including carbohydrates, several amino acids, vitamin A, vitamin B-complex, vitamin K, potassium, calcium, magnesium, zinc, copper, manganese, selenium, boron and dietary fibers. Prunes fiber consist mainly of soluble fraction (80%) including pectin, hemicellulose, cellulose and lignins. Drying process increases the total dietary fibers (Siddiq, 2006). Sorbitol, glucose, fructose and sucrose are major simple sugars. Malic acid is the predominant acid, although citric, tartaric, benzoic and boric acid were also identified in prunes. Difference in flavors depends upon degree of sourness rather than the degree of sweetness (Jhones and Bulls, 1929). Several volatile components have been isolated from *P. domestica* fruit, out of which benzaldehyde, linalool, ethyl nonanoate, methyl cinnamate and γ -decalactone are found to contribute in plum aroma (Ismail and Williams, 1981). Drying causes disappearance of some volatile components and formation of new compounds. Three major compounds identified in dry prunes were benzaldehyde, 2-furancarboxyaldehyde and ethyl cinnamate (Sabarez et al., 2000).

Plums and prunes are rich source of polyphenolic phytochemicals. Total phenolic contents of different plum cultivars have been reported between 282-922 mg/100 g of fruit (Siddiq, 2006). Phenolic compounds of prunes consist mainly of chlorogenic acid, neochlorogenic acid, caffeic acid, coumaric acid, rutin (Donovan et al., 1998) and proanthocyanidin (Kimura et al., 2008). Drying process increases the antioxidant activity due to non-enzymatic reaction products, called melanodins. In prunes, polyphenols contribution in antioxidant activity of prunes is only about 23% of the total antioxidant activity (Madrau et al., 2010).

MEDICINAL AND TRADITIONAL USES

In Unani medicine, prunes are regarded as nutrient, refrigerant, demulcent, cooling, digestive, laxative and tonic. Prunes have been used for centuries in sweet dishes, sauces, rice-meat dish (Biryani). It is used for treatment of acid dyspepsia, nausea, vomiting, to lessen thirst, in bilious fevers and headache. Being somewhat mucilaginous, it cools stomach. Prunes are used in general debility (Usmanghani et al., 1997). Prunes are soaked in a glass of water overnight and the resulting juice is given to patients in morning for the treatment of hypertension (Usmanghani et al., 1986), jaundice and hepatitis (Abbasi et al., 2009). *P. domestica* is used for lowering blood glucose in Elazing Central District of Turkey (Cakilcioglu and Turkoglu, 2009). It is also indicated for the treatment of dysmenorrhea, leucorrhea, miscarriage, asthma and fever (Duke et al., 2002).

PHARMACOLOGICAL ACTIVITIES

Antioxidant activity

Total phenolic contents and total antioxidant capacity of prunes were found higher than other dry fruits including dates, figs and raisins (Wu et al., 2004). Prune extract and juice inhibit oxidation of isolated human LDL (Donovan et al., 1998). Caffeoylquinic acids, hydroxy cinnamic acids, protocatechuic acid, coumarins, lignins and flavanoids present in prunes have high antioxidant activity (Kayano et al., 2004). Methanol elute of water soluble fraction of ethanolic extract of prunes was found to have a novel compound, 4-amino-4-carboxychrome-2-one, which was found to have synergistic action on antioxidant activity of caffeoylquinic acid isomers (Kayano et al., 2002). Neochlorogenic acid and chlorogenic acid isomers in prunes have superoxide anion scavenging activity and inhibit methyl linoleate oxidation (Nakatani et al., 2000). Two lignin glucosides have been isolated from *P. domestica* fruit which have good oxygen radical absorbance activity (Kikuzaki et al., 2004).

Anticancer activity

Ethanol fraction of prune juice has been shown to suppress proliferation and induce apoptotic changes in human colon carcinoma cells (Fujii et al., 2006). Protocatechuic acid in prunes and other fruits has been demonstrated to prevent epithelial cells malignancy in different tissues. The anticancer effects of prunes are probably associated with antioxidant activity of its constituents. Interference with metabolic activation of carcinogens or direct blocking of carcinogen binding with DNA molecules resulting in mutation and neoplastic transformation may also be involved in anticancer activity of protocatechuic acid (Tanaka et al., 2011).

Antihyperlipidemic activity

Daily ingestion of prunes has shown to decrease plasma and LDL cholesterol in mild hypercholesterolemic persons (Tinker et al., 1991). Prune fibers decreased plasma and liver cholesterol in hyperlipidemic rats (Tinker et al., 1994). *In vitro* binding of bile acids with prunes was compared with other fruits and cholestyramine. Total polysacchrides of prunes were found to process 50% bile acid binding capacity of cholestyramine (Kahlon and Smith, 2007). Dried prunes supplementation at level of 9.5% prevents atherosclerosis in apoprotein-E deficient mouse in high cholesterol diet (Gallaher and Gallaher, 2009). Therefore, daily ingestion of prunes may be helpful in atherosclerosis amelioration through lipid and lipoprotein lowering actions.

Blood pressure lowering activity

Caffeic acid decreased reactive oxygen species in angiotensin-II treated vascular smooth muscle cells obtained from stroke prone spontaneously hypertensive rats (SHRSP) and chronic administration of prunes extract hampered elevation of blood pressure in SHRSP (Neigeshi et al., 2007).

Use in age-related cognitive deficits

Regular supplementation of plum juice in rats is effective in mitigating age-related cognitive deficits, which may be attributed to antioxidant activity of plum juice (Shukitt et al., 2009).

Anxiolytic activity

In mouse models of anxiety, chlorogenic acid, in a dose of 20 mg/Kg has anxiolytic effect, which may be mediated through activation of benzodiazepine receptors (Bouayed et al., 2007). Recently, oxidative stress in brain is implicated in pathogenesis of anxiety disorders (Bouayed et al., 2009). Prunes may be beneficial in anxiety disorders due to chlorogenic acid contents and ability to improve in antioxidant defense.

Good for bones

Prunes are very effective in preventing or reversing bone loss (Hooshmand and Arjmandi, 2009). Prunes are rich source of selenium and boron. Both of these trace elements modulate bone metabolism and preserve bone mineral density. Prunes prevented ovariectomy induced loss in bone mineral density in female rats. Inclusion of prunes in diet reversed bone loss in ovarian hormone deficient rats, in orchidectomized male rats (Bu et al., 2007) and in adult and aged male mice (Halloran et al., 2010). Prunes and its polyphenols decrease bone resorption by suppressing nuclear receptor activator for NF- κ B ligand (RANKL) signaling by osteoblasts, which in turn down-regulates osteoclast differentiation and activity. The prunes polyphenols also increase osteoblast activity and function in-vitro, which was associated with up-regulation of key transcription factors and growth factors involved in osteoblast differentiation and collagen crosslinking respectively (Smith, 2007) and direct inhibition of osteoclastogenesis by down-regulating nuclear factor for activated T cells (NFATc1) and inflammatory mediators (Bu et al., 2008). In postmenopausal women, prunes supplementation increased bone formation and decreased resorption, thus decreasing risk of osteoporotic fractures (Arjmandi, 2001; Hooshmand and

Arjmandi, 2009).

Useful in constipation and liver disorders

The prunes were reported to contain oxyphenisatin, which has been shown to act as contact laxative (Ritchie, 1972). High sorbitol contents and chlorogenic acids also contribute to laxative effect of prunes (Stacewicz et al., 2001). In a randomized, double blind crossover study, 260 g /day consumption of yoghurt containing galactooligosaccharides (12 g/day), prunes (12 g/day) and linseed (12 g/day) reduced the severity of constipation in elderly subjects with mild constipation (Sairanen et al., 2007). Daily ingestion of prune juice by human volunteers was found to have mild laxative effect (Piirainen et al., 2007) and significant reduction in serum activities of alanine transaminase and serum alkaline phosphatase (Ahmed et al., 2010). Therefore, prune juice may be useful as mild laxative and beneficial in hepatic diseases.

Toxicity

The eatable portion of prunes is non-toxic. Seeds contain cyanogenic glycosides; amygdalin and prunasin, which upon hydrolysis, release toxic hydrogen cyanide. These glycosides are not hydrolyzed and remain confined in seeds until cell are not damaged. Consumption of improperly processed food containing plum or prunes can cause cyanide poisoning (Vetter, 2000).

Contraindications

There is no report of adverse effects. Many people may have avoided consuming dried plum due to reported laxative effects. But studies demonstrated that consumption of prunes in daily diet up to 100 g by men and postmenopausal women did not significantly change their bowel habits (Tinker et al., 1991; Lucas et al., 2004).

CONCLUSION

Prunes have been found pharmacologically active as antioxidant, anticancer, anxiolytic, mild laxative and antihyperlipidemic. Their efficacy in treatment and prevention of hypercholesterolemia and osteoporosis has been documented in clinical studies. It exerts positive effects on cardiovascular parameters possibly through anti-oxidant activities, high fiber and potassium contents. In conclusion, prunes have wide range of nutritional and medicinal uses and daily consumption can be beneficial in the treatment or prevention of different ailments.

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