

Review



PRUNUS AMYGDALUS: PHYTOCHEMICAL AND PHARMACOLOGICAL REVIEW

Pushpinder Kaur, Vishal Thakur, Seema Brar*
I.S.F College of Pharmacy, Moga Punjab

Submitted on: 15.05.2015

Revised On: 26.05.2015

Accepted on: 28.05.2015

ABSTRACT

Almond trees are a source of beauty, inspiration, food and medicine. They are native to the region which extends from India to Persia; thousands years ago almond tree had spread to east and west of its native region. Almonds are good sources of anti-oxidant nutrients. Almonds contain proteins and certain minerals such as calcium and magnesium. They are a rich source of vitamin E, dietary fiber, B-vitamins, essential minerals mono-unsaturated fats and phytosterols which have cholesterol lowering properties. Almonds are a useful food remedy for anaemia. They are beneficial in the treatment of constipation and various skin diseases like eczema, pimples. The active constituents of almonds are globulins such as amandine and albumin and amino acids such as arginine, histidine, lysine, phenylalanine, leucine, valine, tryptophan, methionine and cystine. Almonds are also useful in treating gastro-enteritis, kidney pains, diabetes, head lice, facial neuralgia and gastric ulcers. This review focuses on the phytochemical composition and the therapeutic uses, along with the pharmacological properties of almonds.

KEY WORDS- *Prunus amygdalus*, Phytochemistry, Anti-oxidant activity, Anti diabetic activity

Corresponding author: Seema Brar
Email: seemabrar001@gmail.com

Indian Research Journal of Pharmacy and Science; 5(2015) 152-159;
Journal home page: <https://www.irjps.in>

INTRODUCTION

Almond is a species of tree native to the Middle East and South Asia. Almonds are prunes. They were traditionally placed in a sub-family, the Prunoideae (or Amygdaloideae), but sometimes, they are placed in their own family, the Prunaceae (or Amygdalaceae) ¹.

The almond tree is a small deciduous tree which grows between 4 and 10 meters in height, with a trunk of up to 30 centimeters in diameter. The young twigs are green at first, when they are exposed to sunlight they become purplish and then grey in their second year. The leaves are 3 to 5 inches long with serrated margins and 2.5 cm petioles. The flowers are pale pink and 3-5 cm in diameter with five petals. In botanical terms, the almond is not a nut, but a drupe which is 3.5 to 6 cm long. The fruit consists of an outer hull and a hard shell with the seed ("hut") inside. Shelling almonds refers to removing the shell to reveal the seed. Almonds are commonly sold shelled or unshelled.

There are three varieties of almonds, all of which produce nuts. One variety of almond produces the sweet nuts, second variety produces poisonous, bitter nuts and a third variety produces a mixture of bitter and sweet nuts. Two major types of almonds which grown commercially can be categorized as sweet almonds (*Prunus amygdalus dulcis*) and bitter almonds (*Prunus Amygdalus amara*). The sweet and the bitter almond can be differentiated on the basis of their flowers. The sweet almond flowers are white in colour, whereas the bitter almond is pink in colour. The kernel of the sweet almond contains a fixed oil and emulsion. The bitter almond is rather broader and shorter than the sweet almond, and contains about 50% of the fixed oil which also occurs in sweet almonds. It also contains the enzyme emulsin which, in the presence of water, acts on a soluble glucoside, amygdalin, yielding glucose, cyanide and the essential oil of bitter almonds. Bitter almonds may yield from 4–9 mg of hydrogen cyanide per almond ^{5,6}.

Prunus amygdalus Batsch (Rosaceae) is an indigenous small tree in the region of the Mediterranean Sea. The edible portion of *Prunus amygdalus* is its nuts known

as almonds and is a popular nutritious food. The nuts of *Prunus amygdalus* are mentioned as medhyarasayana (nootropic agent) in the classical Ayurvedic texts and are also used in folklore practice (Kulkarni et al.) ⁷.

The nuts of *Prunus amygdalus* are found to possess various pharmacological properties, such as anti-stress ⁸, anti-oxidant ⁹, immunostimulant ¹⁰, lipid lowering ¹¹, and laxative ¹². Almond is highly beneficial in preserving the vitality of the brain, strengthening the muscles and prolonging life. Almonds contain copper, iron and vitamins so they are useful food remedy for anaemia.

PHYTOCHEMISTRY

Almonds are a good source of nutrients which are associated with the health of the heart, such as vitamin E, mono unsaturated fatty acids, poly-unsaturated fatty acids (PUFA), arginine, and potassium ¹³

Almonds are among the richest food sources of vitamin E, as RRR- α -tocopherol. Almonds also contain a variety of phenolic compounds which are localized principally in their skin, including flavonols (isorhamnetin, kaempferol, quercetin, catechin and epicatechin), flavanones (naringenin), anthocyanins (cyanidins and delphinidin), procyanidins, and phenolic acids (caffeic acid, ferulic acid, P-coumaric acid and Vanillic acid) ¹⁴.

The active constituents of almonds are globulins such as amandine and albumin and amino acids such as arginine, histidine, lysine, phenylalanine, leucine, valine, tryptophan, methionine and cystine. Almonds contain proteins and certain minerals such as calcium and magnesium. They are also rich in dietary fiber, B vitamins, essential minerals and mono unsaturated fat. Almonds also contain phytosterols which are associated with cholesterol-lowering properties. The phytosterol content of almonds is 187 mg/100mg ¹⁵. Almonds contain approximately 49% oils, of which 62% is mono-unsaturated oleic acid (an omega-9 fatty acid), 24% is linoleic acid (a poly unsaturated omega 6 essential fatty acid) and 6% is palmitic acid (a saturated fatty acid) ¹⁶. A trace of arachidic acid has also been found. Oleum amygdale, the fixed oil, is prepared from either variety of

almonds and it is a glyceryl oleate, with a slight odour and a nutty taste. It is insoluble in alcohol, but it is readily soluble in chloroform.

Almond oil is produced by pressing the almonds without their peels. The sweet almond contains about 26% carbohydrates (12 % dietary fiber, 6.3 % sugars, 0.7 % starch and the rest are miscellaneous carbohydrates); and can therefore be ground into flour to make cakes and cookies for low carbohydrate diets. The sweet almond oil contains fatty acids like palmitic acid, palmitoleic acid, stearic acid, oleic acid, linoleic acid, alpha linoleic acid, arachidic acid, eicosanoic acid, behenic acid, and erucic acid. Sweet almond oil is obtained from the dried kernels of the almond tree and it has excellent emollient properties.

TRADITIONAL USE

Traditionally, almonds have been used for a variety of their properties including antibacterial, aphrodisiac, bladder cancer, breast cancer, chapped lips, colon cancer, demulcent, heart disease, increasing sperm count, mild laxative, mouth and throat cancers, oropharyngeal cancers, phytoestrogen, skin care (emollient), skin moisturizer, solvent for injectable drugs, and uterine cancer. Orally, sweet almond is used as a mild laxative, and as a remedy for cancer of the bladder, breast, mouth, spleen, and uterus. Topically, sweet almond is used as an emollient for chapped skin, to soothe mucous membranes (as a demulcent), and as a weak antibacterial. Parenterally, sweet almond is also used as a solvent for injectable drugs.

Almond oil^{17,18} is an excellent moisturizer and lubricant, which prevents the skin from drying and keeps you free from skin crack¹⁹. From centuries, almond oil had been used for skin allergies, and to treat minor cuts and wounds. Almond Cream contains the almond oil which acts as a beautifying agent and it is useful for all skin types and textures it absorbs in to the skin. It nourishes and revitalizes, protects, soothes and calms the skin.

PHARMACOLOGICAL ACTIVITY

Hyperlipidaemic activity

Almonds contain a variety of phenolic compounds, localized principally in their

epidermal layer including flavonols, flavanols, flavanones, anthocyanins procyanidins (B2 and B3), and phenolic acids (caffeic acid, ferulic acid, p-coumaric acid, protocatechuic acid, vanillic acid) (Amarowicz et al., 2005 and Wijeratne et al., 2006)^{20,21}. Almond flavonols and flavanols have been shown to be bioavailable and contribute to the antioxidant protection against LDL-C oxidation in vitro and in vivo^{22,23}.

In the present study TBARS levels significantly increased in the hyperlipidaemic group. Decreased antioxidant levels are possibly due to their increased utilization combating excessive plasma oxidative stress in hypercholesterolaemic rats. Consequently, decreased TAA in the hyperlipidaemic group might be responsible for the increased peroxidation of the membrane lipids in this group since increased peroxidation of membrane lipids causes reduction in the activity of antioxidative enzymes. Disturbed balance between oxidants and antioxidants due to hyperlipidaemia has been shown before²⁴

On the other hand, there is an increasing but inconclusive body of evidence suggesting that nuts improve antioxidant levels^{25, 26}. Consequently, in the present study pistachio and/or almonds supplementation in the hyperlipidaemic group significantly decreases TBARS levels when compared with the untreated hyperlipidaemic group.

David J.A. et al showed that almonds reduced the biomarkers of lipid per oxidation in hyperlipidaemic patients²⁷. The dose response effects of whole almonds which are considered as snacks, were compared with low saturated fat (<5% energy), whole –wheat muffins (control) in the therapeutic diets of hyperlipidaemic subjects. In a randomized cross over study, 27 hyperlipidaemic men and women consumed 3 isoenergetic (mean 423 kcal/d or 1770 kj/d) supplements, each for 1 month. The supplements consisted of full-dose almonds (73 ± 3g/d), half-dose almonds plus half- dose muffins (half dose almonds), and full dose muffins (control). The subjects were assessed at weeks 0, 2 and 4. Their mean body weights differed (≤ 300g) between the treatments, although the weight loss on the half-dose almond treatment was greater than the weight loss on the control (P<0.01). At 4

weeks, the full-dose almonds reduced the serum concentrations of malondialdehyde (MDA) ($P=0.040$) and the creatinine-adjusted urinary isoprostane output ($P=0.026$), as compared to the control. The serum concentrations of α - or γ -tocopherol, which were adjusted or unadjusted for total cholesterol, were not affected by the treatments. The anti-oxidant activity of almonds was demonstrated by their effect on 2 biomarkers of lipid peroxidation, serum MDA and urinary isoprostanes, and this finding supported the previous finding that almonds reduced the oxidation of LDL-C. Their anti-oxidant activity provides an additional possible mechanism, in addition to lowering cholesterol, that may account for the reduction in CHD risk with nut consumption.

Amnesia

Kulkarni, et al, in their study, suggests that almonds possess a memory enhancing activity in view of its facilitatory effect on the retention of special memory in scopolamine induced amnesia. They concluded that almonds lowered the serum cholesterol in rats. They were also found to elevate the Ach level in the brain and ultimately improve the memory (special and avoidance) of rats²⁸. The paste of the PA nuts was administered orally at three doses (150, 300, and 600 mg/kg) for 7 and 14 consecutive days to the respective groups of rats. Piracetam (200mg/kg) was used as a standard nootropic agent. The learning and memory parameters were evaluated by using an elevated plus maze (EPM), passive avoidance and motor activity paradigms. The brain ChE activity and the serum biochemical parameters like total cholesterol, total triglycerides and glucose were evaluated. It was observed that PA, reduced the brain ChE activity in rats. PA also exhibited a remarkable cholesterol and triglyceride lowering property and slight increase in the glucose levels in the present study. Kulkarni concluded that PA could be a useful memory-restorative agent. It would be worthwhile to explore the potential of this plant in the management of Alzheimer's disease.

Anti-oxidant Action

Antioxidants play a significant role in protecting the body against free radical

damage. Antioxidants refer to a group of compounds that are able to delay or inhibit the oxidation of lipids or other biomolecules and thus, prevent or repair the damage of the body cells that is caused by oxygen. *Prunus amygdalus* is used in traditional for the cure of ulcer. The present study was undertaken on experimental evaluation of petroleum ether and methanolic fruit extracts of *Prunus amygdalus* on antioxidant activity. In this the activity may be correlated with the presence of antioxidant compound were evaluated for their total phenolic content (TPC), total flavonoid content (TFC), ferric reducing ability (parameter (FRAP), 1,1-diphenylpicrylhydrazyl (DPPH) in extract of *Prunus amygdalus* fruit. High antioxidant activity is observed in methanolic fruit extracts of *Prunus amygdalus* compared to other. Thus, it can be considered as innovative sources of natural antioxidants for food and nutraceutical products, potentially²⁹.

Ali Jahanban Isfahan, et al demonstrated that the methanolic extracts of almonds possessed anti-oxidant and anti radical activities and that their phenolic extract may be helpful in preventing or slowing the processes of various oxidative stress related diseases. On the basis of the comparison between the anti-oxidant and the anti radical activity of wild almond hull and shell phenolic extracts, 4 almond species were selected. The fruits of these almonds were collected, their hulls and shells were dried and ground, and methanolic extracts were prepared from these hulls and shells. The total phenolic content was determined by using the Folin-Ciocalteu (F-C) method. The reducing power and the scavenging capacity of the extracts for radical nitrite, hydrogen peroxide, and superoxide were evaluated. The results showed that the anti-oxidant and the anti-radical activities of the almond hull were higher than those of its shell phenolic extract among correlated with the phenolic content and radical scavenging capacities of wild almond hull and shell extracts in different species were positively correlated with phenolic content and reducing power³⁰.

Immunostimulant Action

Immunostimulants, also known as immunostimulators, are substances (drugs and nutrients) that stimulate the immune

system by inducing activation or increasing activity of any of its components. One notable example is the granulocyte macrophage colony-stimulating factor. Adriana Arena, et al, evaluated in their study, that with almonds, high levels of cytokine production were observed i.e., interferon- α (INF- α), interleukins (IL-12), INF-gamma and tumour necrosis factor (TNF- α). Their data suggested that almonds improved the immune surveillance of the peripheral blood mono nuclear cells towards viral infections. Almonds also were found to induce a significant decrease in the Herpes simplex virus (HSV-2) replication³¹.

Aphrodisiac Action

An aphrodisiac is a substance that, when consumed, increases sexual desire. Aphrodisiacs are distinct from substances that address fertility issues such as impotence or secondary sexual dysfunction such as Erectile dysfunction.

Gopu Madhavan, et al, in their study with a polyherbal formulation (Tentex Royal) which contained *Prunus amygdalus* along with other herbal preparations, showed a significant improvement in all the parameters of the sexual indices. To assess the efficacy of Tentex royal, a polyherbal formulation, in enhancing the male sexual activity in an experimental model, the study involved virgin female rats which were in the oestrous state, which was induced by administering oestrogen, and male rats which were randomized into five groups and were classified into the control group, the sildenafil citrate reference standard group and the Tentex royal-treated group (125, 250 and 500 mg/kg) respectively, for 5 days. Parameters such as total sexual behaviour, mounting frequency, ejaculation frequency, ejaculation latency, serum testosterone levels and sperm count were carefully monitored. A significant improvement in all the parameters of the sexual indices was observed in the Tentex royal group. The treatment with Tentex royal also showed an increase in the sperm count and the testosterone levels. Histological evaluation of the anterior pituitary revealed an increase in the FSH-LH-producing basophils and a decrease in the ACTH producing cells. The study revealed that Tentex royal improved the erectile capacity. Considering the

limitations of sildenafil citrate in clinical practice, Tentex royal may be considered a safe and alternative treatment for the correction of erectile dysfunction³².

Hepato Protective Action

Manoj Soni et al reported the hepato protective activity of the *Prunus* extract against Paracetamol and CCl₄ induced hepatitis in rats. The extract of methanol: ethanol (70:30) of *Prunus* was prepared and tested for its hepato-protective effect against Paracetamol and CCl₄ induced hepatitis in rats. An alteration in the levels of the biochemical markers of hepatic damage like SGPT, SGOT, ALP, total bilirubin, direct bilirubin and tissue LPO, GSH, catalase and SOD were tested in both the treated and untreated groups. Paracetamol (2g/kg) and CCl₄ (1.5ml/kg) enhanced the SGPT, SGOT, ALP, total bilirubin, direct bilirubin and the tissue levels of GSH. The treatment with the extract of the *Prunus* fruits (150mg/kg and 300mg/kg) brought back the altered levels of the biochemical markers to near normal levels in a dose dependent manner³³.

Anxiolytic Activity

Anxiety is the displeasing feeling of fear and concern. When anxiety becomes excessive, it may be considered as an anxiety disorder³⁴. Anxiety disorders such as generalized anxiety, panic and obsessive-compulsive disorders, phobias or post traumatic stress disorders are common and major cause of disability^{35,36}.

The nuts of *Prunus amygdalus* (almond) are found to possess anti-stress properties, also is an effective health building food, both for the body and the mind. Anxiolytic activity of *Prunus amygdalus* dulcis were studied using open-field tests in mice. The efficacy of two doses of *Prunus amygdalus* dulcis 800 and 1600 mg/kg was compared with standard anxiolytic drug the diazepam (1mg/kg). Both the diazepam and almond (1600 mg/kg) treated groups in this study showed extremely significant increased ($p < 0.001$) in both the number of rearing against the wall and the time spend in central squares with significant increase in the number of crossed squares ($p < 0.01$) and ($p < 0.05$) respectively. The number of grooming was extremely significant decreased ($p < 0.001$) while the duration of grooming showed no significant difference

($p > 0.05$) in compare to the control group. The group that given 800mg/kg of almond showed highly significant decrease ($p < 0.01$) in the number of grooming while the duration of grooming was extremely significant increased ($p < 0.001$) with no significant difference ($p > 0.05$) in the number of rearing against the wall, the time spend in central squares and the number of squares crossed in compare to the control group. These findings suggest that *Prunus amygdalus dulcis* in a dose 1600 mg/kg possess anxiolytic-like properties equal to that of diazepam while 800mg/kg *Prunus amygdalus dulcis* has less effect³⁷.

Anti diabetic activity

Diabetes mellitus is the most common endocrine disorder more than 150 million people are suffering from it worldwide and it is likely to increase to 300 million by the year 2025. In view of the adverse effects associated with the synthetic drugs and considering natural medicine safer, cheaper and effective, traditional antidiabetic plants can be explored diabetes in India. The ethanolic extract (250 & 500 mg/kg) of leaf, flower and seed of *Prunus amygdalus* were taken up undertaken to evaluate the antidiabetic activity against normal and streptozotocin induced diabetic mice. Oral administration of Extract for 21 days resulted in significant reduction in blood glucose level. Chronic effect of the extract on serum biochemistry were also studied and it was found that serum cholesterol, triglyceride, creatinine, urea, alkaline phosphatase levels were decreased significantly by all the extracts and glibenclamide but HDL levels and total proteins were found to be increased after treatment³⁸.

Anti aging activity

Prunus amygdalus is used extensively in cosmetic formulation owing to its copious properties. In this investigation herbalcosmetic formulation comprising of *Prunus amygdalus* skin extract was prepared and evaluated for the protection of skin from solar ultraviolet induce photoaging. To investigate the antiaging activity of prepared formulations the UVB-induced oxidative stress was generated in mice

and Protective effects were observed after topical treatment of prepared formulation (0.2 mg cm²day⁻¹), 2 hrs prior to UV exposures. Biochemical investigations (lipid peroxidation and glutathione) were carried out to evaluate the photoprotective effect of prepared formulation. The change in level of moisture content in formulation treated mice skin group as compared to UV irradiated control mice group was also estimated. The prepared formulation treated mice skin groups showed stronger antioxidant activity by significantly decreased and increased MDA and GSH level respectively as compared to irradiated control group. Remarkable difference could be seen in moisture content in formulation treated mice skin as compared to irradiated control and thus it's confirmed from moisture content and biochemical investigations that topical application of *Prunus amygdalus* skin extract containing formulation possesses antiwrinkle properties³⁹.

CONCLUSION

In the present study, we have discussed the chemical composition, therapeutic uses and the pharmacological actions of *Prunus amygdalus*. In the past few years, many promising bioactivities such as hypolipidaemic, hypoglycaemic, immunostimulant, anti-oxidant activity of *Prunus amygdalus* have been reported. Also, for the first time, an aphrodisiac and an agent for increasing the fertility have been realized. The pharmacological and medicinal significance of *Prunus amygdalus* is gradually increasing. Therefore, it is high time to investigate the bioactivities and chemical composition of the unexplored plants of *Prunus* and to devote more efforts towards understanding the mechanism of action of the bioactive constituents which are present in them.

ACKNOWLEDGEMENT

We express our sincere thanks to the management and Shri. Parveen Garg, Honourable Chairman, ISF College of Pharmacy, Moga, Punjab, India, for providing necessary facilities.

REFERENCES

- Potter D, Eriksson T, Evans RC, Oh S, Smedmark JEE, Morgan DR, et al., Phylogeny and classification of Rosaceae., *Pl. Syst. Evol.*, 2007; 266: 5–43
- Bailey LH, Bailey EZ, the staff of the Liberty Hyde Bailey Herbarium. *Hortus third: A concise dictionary of Plants Cultivated in the United States and Canada*. Macmillan, New York, 1976.
- Keith R. *Collins wildlife trust guide trees: A photographic guide to the trees of Britain and Europe*. London: Harper Collins, 1999
- Mark GD, Huxlen AJ, *The New Royal Horticultural Society dictionary of gardening*, London, Macmillan Press, 1992
- Karkocha I, Semiquantitative method of hydrogen cyanide and sweet almonds, *Roczniki Państwowego Zakładu Higieny*, 1973; 24 (6): 703–5.
- Shragg TA, Albertson TE, Fisher CJ., Cyanide poisoning after bitter almond ingestion., *West. J. Med.*, 1982; **136** (1): 65–9.
- Kulkarni K. S, Kasture S. B, Mengi, S. A., Efficacy study of Prunus amygdalus (almond) nuts in scopolamine-induced amnesia in rat., *Indian J. Pharmacol.*, 2010; 42:166-173.
- Bansal P, Sannd R, Srikanth N, Lavekar GS., Effect of a traditionally designed nutraceutical on the stress induced immunoglobulin changes at Antarctica., *Afr J Biochem Res* 2009; 3:1084-88.
- Pinelo M, Rubilar M, Sineiro J, Nunez MJ., Extraction of anti-oxidant phenolics from almond hulls (Prunus amygdalus) and pine sawdust (Pinus pinaster)., *Food Chem.*, 2004; 85:267-73.
- Puri A, Sahai R, Singh KL, Saxena RP, Tan don JS, Saxena KC., Immunostimulant activity of dry fruits and plant materials which are used in the Indian traditional medical system for mothers after child birth and invalids., *J Ethnopharmacol.*, 2000; 71:89-92.
- Spiller GA, Jenikins DA, Bosello O, Gates JE, Cragen LN., Bruce nuts and plasma lipids: An almond –based diet lowers the LDL-C while it preserves the HDL-C., *J Am Coll Nutr.*, 1998; 17:285-90.
- Sharma RP, Saamhita C, Agnivesha Treatise., Sutrashana. Varanasi: Chokambha Sanskrit Sansthan; 1981.
- Nuts, almonds [online]. USDA National Nutrient Database for Standard Reference, Release 17 (2004). Agricultural Research Service, U.S. Department of Agriculture. <http://www.nal.usda.gov/fnic/foodcomp/search/index.html>.
- Frison-Norrie S, Sporns P., Identification and quantification of flavonol glycosides in almond seed coats by using MALDI-TOF.MS., *J. Agric. Food Chem.*, 2002; 50:2782-2787.
- Phillips KM, Ruggio DM, Ashraf-khorassani M., The phytosterol composition of the nuts and seeds which are commonly consumed in the United States., *J Agric Food Chem.*, 2005; 53:9436-45.
- Berry EM, Eisenberg S, Friedlander Y., Effects of diets which are rich in mono-unsaturated fatty acids on the plasma lipoproteins – the Jerusalem Nutrition Study II. Mono-unsaturated fatty acids Vs Carbohydrates., *Am J Clin Nutr.*, 1992; 56:394-403.
- Karl-Franzens-Universität (Graz). "Almond (Prunus dulcis [Mill. D. A. Webb.])".
- G. Ladizinsky (1999). "On the origin of almond". *Genetic resources and crop evolution* 46 (2): 143–147
- Sweet almonds, effectiveness, safety and drug interactions on Rxlist. www.rxlist.com; vitamin, herbs, dietary supplements
- AMAROWICZ, R., TROSZYNSKA, A. and SHAHIDI, F., Antioxidant activity of almond seed extract and its fractions., *J. Food Lipids.*, 2005; 12:344–358.
- WIJERATNE, S.S.K, ABOU-ZAID, M.M. and SHAHIDI, F., Antioxidant polyphenols in almond and its coproducts., *J. Agric. Food Chem.* 2006; 54:312–318.
- Jenkins D. J, Kendall C. W, Marchie A, Parker T. L, Connelly P. W, Qian W., Haight J. S, Faulkner D., Vidgen E et al., Dose response of almonds on coronary heart disease risk factors: blood lipids, oxidized low-density lipoproteins, lipoprotein (a), homocysteine, and

- pulmonary nitric oxide: a randomized, controlled, crossover trial. *Circulation.*, 2002; 106: 1327–1332.
23. Chen CY, Milbury PE, Lapsley K, and Blumberg JB., Flavonoids from almond skins are bioavailable and act synergistically with vitamins C and E to enhance hamster and human LDL resistance to oxidation., *J Nutr.*, 2005; 135: 1366–1373.
 24. Emekli-Alturfan E, Kasikci E and Yarat A., Peanut (*Arachis hypogaea*) consumption improves glutathione and HDL cholesterol levels in experimental diabetes., *Phytother. Res.*, 2008; 22:180-184.
 25. Kocyigit A, Koylu AA, and Keles H., Effects of pistachio nuts consumption on plasma lipid profile and oxidative status in healthy volunteers., *Nutr. Metab. Cardiovasc. Dis.*, 2006; 16: 202-209.
 26. Gentile C, Tesoriere L, Butera D, Fazzari M, Monastero M, Allegra M and Livrea MA., Antioxidant activity of Sicilian pistachio (*Pistacia vera* L. var. Bronte) nut extract and its bioactive components., *J. Agric. Food Chem.*, 2007; 55: 643-648.
 27. Jenkins DJA, Kendall CWC, Marchie A, Josse AR, Nguyen TH, Fowlhner DA, Lapsley KG, Blumberg J., Almonds reduce the biomarkers of lipid per oxidation in older hyperlipidaemic subjects., *J. Nutr* 2008; 138: 908-13.
 28. Kulkarni KS, Kastura SB, Mengi SA., Efficacy of the *Prunus amygdalus* (almonds) nuts in scopolamine induced amnesia in rats., *Indian J Pharmacol.*, 2010; 42: 168-73.
 29. Devendra Kumar, Pragya Seth. Antioxidant activity of fruit extracts of *Prunus amygdalus*
<http://www.pharmatutor.org/articles/determination-of-anti-oxidant-activity-of-prunus-amygdalus>
 30. Isfahlan AJ, Mahmoodzadeh A, Hassanzadch A, Heidari R, Jamai R., Anti-oxidant and anti radical activities of the phenolic extracts of the hulls and shells of the Iranian almond (*Prunus Amygdalus*)., *Turk J Biol.*, 2010; 34: 165-73.
 31. Arena A, Bisignano C., The immunomodulatory and the antiviral activities of almonds., *J.I m let.*, 2010; 132 (1-2): 18-23.
 32. Gopumadhavan S, Rafiz M, Venkataranganna MV, Kulkarni K, Mitra SK., Assessment of “Tentex royal” for sexual activity in an experimental model., *Indian Journal of Clinical Practice* 2003; (13), 10: 23-26.
 33. Soni M, Mohanthy PK, Jaliwala YA. Hepato protective activity of the fruits of *Prunus*., *International Journal of Pharma and Biosciences.*, Apr 2011; 2 (2): 439-452.
 34. Tripathi KD, Jay Pee. Essentials of medical pharmacology, 6th.
 35. Ernst's Herbal remedies for anxiety- (2004) a systemic review of controlled clinical trials, *Phytomedicine*;1(4)3-3.
 36. Lavie CJ., Milani RV., Prevalence of anxiety in coronary patients with improvement following cardiac rehabilitation and exercise training., *American Journal of Cardiology.*, 2004 ; 93: 336-339.
 37. Zena Hasan Sahib., Assessment of Anxiolytic Activity of Nuts of *Prunus Amygdalus Dulcis* (Almond) in Mice., *Medical Journal of Babylon.*, 2015;11:4 ,
 38. Shah K H, Patel J B , Shurma V J , Shurma R M, Patel R P and Chaunhan U., Evaluation of Antidiabetic Activity of *Prunus Amygdalus Batsch* in Streptozotocin Induced Diabetic Mice., *Research Journal of Pharmaceutical, Biological and Chemical Sciences.*, 2011; 2(2): 430
 39. Monika Katyal Sachdeva, Taruna Katyal, Abatement Of Detrimental Effects Of Phot oaging By *Prunus Amygdalus* Skin Extract *International Journal of Current Pharmaceutical Research* Vol 3, Issue 1, 2011 57-59

Conflict of Interest Reported: Nil; Source of Funding: None Reported