



PHARMACOLOGICAL IMPORTANCE OF *CYDONIA OBLONGA*- A REVIEW

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ABSTRACT

Plants are not only a dietary source for human beings and animals but also are phytomedicines. Herbs are much safer than synthetic formulations because they have less side effects. Traditionally plants are used in Unani, Chinese and Ayurvedic system of therapies to treat various diseases. Quince (*Cydonia oblonga*) is a tree belonging to Rosaceae family which is cultivated for its nutritional value in Caucasus and Northern Iran. Leaves, peels, pulp and seeds of quince contain high amount of phenolic components, organic acids, essential oils, polyphenolic components and free amino acids. Traditionally, Quince fruits are used to treat fever in digestive disorder, diarrhea, dysentery, abdominal pain, constipation and bloating, gastric tonic, ulcer-healing, hemorrhoid bleeding, antiemetic agent, nervousness, insomnia, hypertension, metabolic diseases, diseases of respiratory system, and as astringent, anti-inflammatory. Scientific literature shows many other activities like antibacterial, anti-allergic, anticancer, antidiabetic, aphrodisiac, wound healing and hypolipidemic activity.

KEYWORDS: Classification of *Cydonia oblonga*. Chemical constituents of *Cydonia oblonga*. Pharmacological Activity of *Cydonia oblonga*.

1. INTRODUCTION

Plants are very essential for both human beings and animals not only as a dietary source but also as safer phytomedicine. Traditionally, phytomedicine has been used to treat various diseases in Ayurvedic, Chinese and Unani system of therapies for better treatment of various diseases. The curing potential of phytomedicine has been supported by many scientific evidences. In recent time there are many new challenges for the health care, so researchers are focusing on the plants to separate the new potent and active phytomedicine. More than 25,000 plant based drug formulation has been acknowledged as phytomedicine in traditional Indian folk medicine.^[1] Quince (*Cydonia oblonga* Miller) is a deciduous tree of Rosaceae family which is cultivated in precincts under warm temperature in Caucasus and Northern Iran.^[2] and widely spread to the Middle East, Greece and around the Mediterranean. Now a day's Turkey is the largest producer of quince followed by Iran, China, Morocco and Argentina.^[3] In India, Himachal, Punjab and Kashmir produce quince.^[4, 5] The Quince pomes are apple-shaped (var. *maliformis*) which have an aromatic, drier and harder flesh or pear-shaped (var. *pyriformis*) which have fine and softer flesh.^[6] Quince fruits are used to prepare pickle, candy, preserve, squash, jam and chutney.^[4] Quince is a low fat fruit and a major source of organic acid, sugar, fibers and minerals such as potassium, phosphorus and calcium.^[7] Several studies

have been shown that the *Cydonia oblonga* fruit is a good and less expensive natural source of phenolic acid and flavonoids which are very effective antioxidants and it contains high amount of cell-wall polysaccharide which makes it as a potential source of dietary fibers and pectin. Among dietary antioxidants, phenolic compounds, secondary metabolites from plants are rich with natural antioxidants.^[8]

2. Scientific classification

2.1 Common names:-Urdu: Bahee Dana, Farsi: Beh, Greek: Strythion^[5] Arabic: Sefarjal, English: Quince, German: Quitte, Russian: Ajva, Hindi: Behi, Sanskrit: Amritphal, Kashmir: Bamasutu, Telgu: Samadanma.^[9,10]

2.2. Taxonomy:-*Cydonia oblonga* is a shrub or little tree belonging to the genus *Cydonia*. Quince plants are 5-8m tall and 4-5m wide while fruits are 7-12cm in length and 6-9cm wide with yellow blush. Fruits have characteristic odor, astringent flavor and plano-convex seeds which are arranged in two vertical rows. Quince leaves are 6-11cm long and elliptical in shape with white hairs on the exterior side.^[1]

2.3. Optimum Storage Conditions

Optimum storage temperature of quince is -0.5°C to 0°C (31 to 32 °F) with about 90% RH and Storage life in air at -0.5°C (31 °F) is 2 to 3 mo.^[11]

2.4. Traditional uses

Table. 1. Traditional uses of *Cydonia oblonga*

Parts	Use
Leaves	astringent, antiseptic ^[9]
Seed	astringent, emollient and also used for the treatment of diarrhea, dysentery, cough, sore throat, bronchitis, intestinal colic and constipation. ^[12]
Fruits	astringent, gastric tonic, ulcer-healing, anti-inflammatory, antiemetic and suitable to cure hemorrhoid bleeding ^[13] , fever in digestive disorder, diseases of respiratory system, constipation and bloating, inflammation of the kidneys, urinary tract and bladder, hypertension and metabolic diseases like hypercholesterolemia, hyperlipidemia, diabetes mellitus. ^[14] , nervousness, insomnia, abdominal pain, diarrhoea, dysentery, leucorrhoea, haemoptysis, uterine haemorrhages, wounds and many skin diseases, also as sedative, antipyretic, antiseptic, cicatrizing and hepatoprotective agent. ^[9,15]

Scientific literature shows that *Cydonia oblonga* possesses antiulcerative activity, wound healing activity, antiproliferative activity, antioxidant activity, antiradical activity, antimicrobial activity, antihemolytic activity, also has the inhibitory effect on IgE immune reactions, antiallergic activity, lipid lowering activity and antidiabetic activity.^[16,13]

2.5. Chemical constituents

Phenolic composition:-Leaves of *Cydonia oblonga* contains higher phenolic content than peels, pulps and seeds. The phenolic profile of quince is made up of nine compounds.

Leaves:- 3-O-, 4-O-, 5-O- caffeoylquinic acids, 3,5-O-dicaffeoylquinic acid, quercetin-3-O-galactoside, quercetin-3-O-rutinoside, kaempferol-3-O-glucoside, kaempferol-3-O-rutinoside and kaempferol-3-O-glycoside.^[17]

Seeds:-lucenin-2, vicenin-2, stellarin-2, isoschaftoside, schaftoside, 6-C-pentosyl-8-C glucosyl chrysoeriol and 6-C-glucosyl-8-C-pentosyl chrysoeriol, kaempferol-3-O-rutinoside.^[18]

Organic acid composition

Quince fruits and leaves:-citric acid, malic, quinic, shikmik and fumaric acid.

Pulps and peels:-ascorbic acid.^[18]

Seeds:-Seeds of quince contains fat soluble bioactive compounds including tocopherols, phytosterols and phenolic acids. Tocopherols consisted of α -tocopherol, β -tocopherol, γ -tocopherol and δ -tocopherol possesses the highest vitamin E activity among others. Phytosterols were campesterol, stigmasterol, sitosterol, avasterol. β -sitosterol is specific phytosterol which reduces LDL cholesterol levels.^[19]

Polyphenolic composition

Total 26 polyphenolic compounds found in quince tissues: 9 flavan-3-ols including (-)-epicatechin, procyanidin B2, 3 procyanidin dimers and trimers and 1 tetramer; 8 hydroxycinnamates (derivatives of caffeoylquinic and coumaroylquinic acid) and 9

kaempferol and quercetin derivatives. Flavan-3-ols is the major class of quince polyphenol.^[20]

Free amino acids:- Quince seeds contains 21 identified free amino acids. Alanine, Glycine, Leucine, Valine, Proline, Serine, Isoleucine, Threonine, Methionine, Hydroxyproline, Cysteine, Glutamine, Phenylalanine, Ornithine, Lysine, Histidine, Tyrosine, Tryptophan and the three most important acids are Glutamic and Aspartic acids and Asparagines.^[21]

Essential oils:- During flowering period *C.oblonga* leaves contains essential oils which are Aromatic aldehyde [benzaldehyde], followed by fatty acid [hexadecanoic acid], oxygenated monoterpene [linalool] norisoprenoid [(E)- Ionone. Sesquiterpene hydrocarbon [germacrene D] and aromatic aldehyde [benzaldehyde] are the main components in the essential oil from leaves of *C. oblonga* in the fruiting period.^[5]

2.6. Pharmacological activity

2.6.1 Anti-diarrheal Activity

Janbaz K H et al. was described spasmolytic /spasmodic activity of crude extract of *cydonia oblonga* seeds in isolated guinea pig ileum and rabbit jejunum. This seeds extract produce prokinetic effect, muscle relaxation, reduce smooth muscle spasm in rabbit jejunum like verapamil and also induced atropine sensitive spasmodic effect on isolated ileum of guinea-pig like acetyl choline. This spasmodic effect activated the muscarinic receptors, in the gut that relieve constipation.^[12]

2.6.2. Anti colitis activity

Minaiyan M et al investigated that quince juice (QJ) and quince hydroalcoholic extract (QHE) were effective to treat ulcerative colitis (UC) which was induced by TNBS (trinitrobenzene sulfonic acid) in rats with different doses of QJ (200, 400, 800 mg/kg), QHE (200, 500 & 800 mg/kg) orally, QJ (400 mg/kg) and QHE (200 and 500 mg/kg) intraperitoneally. Both QJ and QHE at the dose of 200, 500mg/kg significantly alleviated inflammation and colon damage like dexamethasone.^[22]

2.6.3. Anti Cancer activity

Ma'rcia C et al. reported that the phenolic component of quince leaf and fruit (pulp, peel and seed) are effective

against human kidney and colon cancer cells and useful as a cancer chemotherapeutic agent.^[23] It also have antitumor activity because these extracts inhibits viability of human colon adenocarcinoma LS174 cells. The antiproliferative activity of quince pulp and peel was confirmed by measuring the cell proliferation and cytotoxicity with MTT and LDH assays.^[24]

2.6.4. Anti-inflammatory activity

Anti-inflammatory activity of *Cydonia oblonga* was evaluated by arachidonic acid-induced ear edema and carrageenan-induced paw edema in rats and it has been demonstrated that quince leaves inhibits NO, LPO, IL-6 and TNF- α levels which reduces arachidonic acid-induced ear edema and carrageenan-induced paw edema.^[25]

2.6.5. Anti-allergic effect

In a study Hot water extract of quince was used to cure type-1 allergic reactions and was found that it decreases the development of atopic dermatitis-like skin lesions under usual conditions because hot water extract of quince inhibited the release of beta-hexosaminidase from rat basophilic leukemia cell line RBL-2H3 and it was confirmed that due to suppression of IgE production and IgE-mediated degranulation it has inhibitory effect on type-1 allergy.^[26] In an another study it has been found that the crude hot water extract of quince fruits was effective against IgE dependent late phase allergic reaction of mast cell.^[27] Hoffmann A *et al.* describes that the nasal spray of *Cydonia oblonga* is traditionally used in Germany and Switzerland to treat the symptoms of hay fever because it inhibit the histamine release from mast cells in vitro. This activity of quince was studied on grass pollen allergic patients by randomized placebo controlled cross over study and found it is effective significantly in hay fever.^[28]

2.6.6. Anti microbial activity

Fattouch S reported antimicrobial activity of aqueous acetone extract of quince by using some microorganism: *Staphylococcus aureus* (ATCC6538) for Gram-(+) bacteria, *Escherichia coli* (ATCC 8739), *Pseudomonas aeruginosa* (ATCC 9027) and a *Salmonella* sp. strain (isolated from food) for Gram-(-) bacteria, the yeast *Candida albicans* (ATCC 14053), and the mould *Aspergillus niger*.^[29]

2.6.7. Cardiovascular effect

Wenting Z *et al.* assessed that the ethanolic extract of quince fruits and leaves has been effective to cure the blood pressure and blood rheology in hypertensive Wistar rat with 160 mg/kg dose by Goldblatt two-kidney one clip model. *Cydonia oblonga* inhibits angiotensin converting enzyme (ACE).^[30] Another study has been shown that aqueous extract of quince fruit prolonged the bleeding and clotting time as compare with aspirin in Wistar rats through tail cutting and glass slide methods. It increases thrombolysis, 6-keto-PGF1 α and reduces euglobulin lysis time (ELT), pulmonary embolus

mortality and plasma concentration of TXB2.^[31] Magalhaes Ana. S *et al* has been reported that the methanolic extract of pulps and peels of quince fruit possess protective effect against oxidative hemolysis of human erythrocytes which was induced by AAPH while seeds showed extensive hemolysis due to presence of phenolic component.^[32]

2.6.8. Anti-oxidant potential

A study has been shown that phenolic acid and flavonoids component were isolated from methanolic extract of quince leaves of Tunisian variety have stronger antioxidant activity than BHT.^[33]

Methanolic extract of quince pulp, peel and seeds was studied by Silver *et al.* and reported that the peel methanolic extract contain the highest potent antioxidant and was comparable to ascorbic and citric acid.^[34]

2.6.9. Anti diabetic activity

Antidiabetic activity of quince extract was demonstrated by Aslan M *et al.* in streptozotocin induced diabetic rats. Quince extract decreases the blood glucose level significantly at dose of 500mg/kg oral.^[35]

2.6.10. Hypolipidemic activity

Hypolipidemic activity of aqueous extract of quince fruit was evaluated by Mirmohammadlu M *et al.* in Sprague Dawley diabetic rats and reported that aqueous extract of quince fruit decreases the serum triglyceride, total cholesterol and low density lipoprotein cholesterol (LDL-C) levels along with the elevation of high density lipoprotein cholesterol (HDL-C).^[36]

2.6.11. Aphrodisiac activity

Hydro alcoholic extract of *C. oblonga* Miller fruit possess aphrodisiac activity at the dose of 500mg/kg and 800mg/kg. After administration of extract mating performance and mounting frequency of rats were enhanced markedly ($P < 0.01$).^[13]

2.6.12. Wound healing property

Quince seed mucilage has better healing effect on dermal toxicity caused by T2-toxin and it increases the tensile strength, wound fluid levels of growth factors (EGF, TGF-beta2, VEGF, PDGF) and collagen synthesis of wound tissue which was investigated by Tamri *et al* in rabbits through full thickness wound model.^[37]

2.6.13. Toxic effects of quince

Seeds of quince fruit are hazardous to eat in case of breast-feeding because seeds have nitriles which hydrolysed in stomach by enzymes and stomach acid and produce hydrogen cyanide. Excess consumption of quince seeds produce toxicity. Several studies with *C. oblonga* fruits illustrated the presence of cyanogenic glycosides such as amygdalin and prunasin.^[37]

CONCLUSION

Plants are not only a dietary source for human beings and animals but also are phytomedicines. Herbal drugs are much safer than synthetic formulations because they have less side effects. Traditionally plants are used in Unani, Chinese and Ayurvedic system of therapies to treat various diseases. Several studies have been shown that the *Cydonia oblonga* fruit is a good and less expensive natural source of phenolic acid and flavonoids which are very effective antioxidants and it contains high amount of cell-wall polysaccharide which makes it as a potential source of dietary fibers and pectin. Among dietary antioxidants, phenolic compounds, secondary metabolites from plants are rich with natural antioxidants. These review discusses the chemical constituents, pharmacological and therapeutic effect of *Cydonia oblonga* as promising herbal drug because of its safety and effectiveness.

REFERENCES

- Ashraf UM, Muhammad G, Hussain A M, Bukhari SN. *Cydonia oblonga* mill., A medicinal plant rich in phytonutrients for pharmaceuticals. Review Ethnopharmacology, a section of the journal Frontiers in Pharmacology, 2016; 1(5): 33-43.
- Ashrafi H, Ghabili K, Alihemmati A, Jouyban A, Shoja MM, Aslanabadi S, Hami Adl F, Ghavimi H, Hajhosseini L. The effect of quince leaf (*Cydonia oblonga* miller) decoction on testes in hypercholesterolemic rabbits: a pilot study. 2013; 277-282. <http://dx.doi.org/10.4314/ajtcam.v10i2.12>.
- Ganopoulos I, Merkouropoulos G, Pantazis S, Tsiouridis C and Tsiftaris A. Assessing molecular and morpho-agronomical diversity and identification of ISSR markers associated with fruit traits in quince (*Cydonia oblonga*). Genetic and Molecular research, 2011; 2729-2746, [doi.org/10.4238/2011.November.4.7](http://dx.doi.org/10.4238/2011.November.4.7).
- Sood S, Bhardwaj M. Nutritional Evaluation of Quince Fruit and its Products. J Krishi Vigyan, 2015; 67-69. DOI: 10.5958/23494433.2015.00039.2.
- Sajid MS, Zubair M, Waqas M, Nawaz M, Ahmad A. A Review on Quince (*Cydonia oblonga*): A Useful Medicinal Plant, 2015; 14(4): 517-524. DOI: 10.5829/idosi.gv.2015.14.04.93154.
- Rop O, Bali J, Juríková T, Škardová P, Salaš P, Sochor J, Mlček J, Kramářová D. Chemical Characteristics of Fruits of Some Selected Quince (*Cydonia oblonga* Mill.) Cultivars. Czech J. Food Sci, 2011; 29(7): 65-73.
- Leonel M, Leonel S, Tecchio AM, Mischan MM, Moura FM, Xavier D. Characteristics of quince fruits cultivars' (*Cydonia oblonga* Mill.) grown in Brazil. Australian journal of crop science, 2016; 10(5): 711-716. [doi.10.21475/ajcs.2016.10.05.p7425](http://dx.doi.org/10.21475/ajcs.2016.10.05.p7425).
- Mir SA, Masoodi FA, Gani A, Ganaie AS, Reyaz U, Wani SM. Evaluation of antioxidant properties of methanolic extracts from different fractions of quince (*Cydonia oblonga* Miller). J. Advances in Biomedicine and Pharmacy, 2015; 1-6.
- Ali E, The medical importance of *Cydonia oblonga* Review: IOSR Journal of Pharmacy, 2016; 87-99.
- Al-saify AE. Therapeutic properties of medicinal plant: a review of their GIT. Ind J of pharm science and Research, 2015; 5(3): 218-219.
- Janbaz KH, Shabbir A, Mehmood MH, Gilani AH. Insight into mechanism underlying the medicinal use of *Cydonia oblonga* in gut and airways disorders. The Journal of Animal and Plant Science, 2013; 2(1): 330-336.
- Aslam M, Sial AA. Effect of Hydroalcoholic Extract of *Cydonia oblonga* Miller (Quince) on Sexual Behaviour of Wistar Rats. Advances in Pharmacological Sciences Volume 2014; 6 <http://dx.doi.org/10.1155/2014/282698>.
- Monka A, Grygorieva O, Chlebo P, Brindza J. Morphological and antioxidant characteristics of quince (*Cydonia oblonga* mill.) and chinese quince fruit (*Pseudocydonia sinensis* schneid.). Potravinarstvo® Scientific Journal for Food Industry 2014; 333-340.
- Vaez H, Hamidi S, Arami S. Potential of *Cydonia oblonga* leaves in cardiovascular disease. Hypothesis, 2014; 1-10 [doi:10.5779/hypothesis.v12i1.356](http://dx.doi.org/10.5779/hypothesis.v12i1.356).
- Aslam M, Hussain Z. The Effect of Hydro-alcoholic Extract of *Cydonia oblonga* Miller (Quince) on Blood Cells and Liver Enzymes in New Zealand White Rabbits, Ethnopharmacology Vol. 2013; (3): 1-4.
- Oliveira PA, Pereira AJ, Andrade PB, Valentao P, Seabra MR, Silva BM. Organic acids composition of *Cydonia oblonga* miller leaf. Journal: Food Chemistry 393-399. [doi:10.1016/j.foodchem.2008.04.004](http://dx.doi.org/10.1016/j.foodchem.2008.04.004).
- Oliveira PA, Costa MR, Magalhaes SA, Pereira AJ, Carvalho M, Valentao P, Andrade PB, Silva BM. Targeted metabolites and biological activities of *Cydonia oblonga* miller leaves. J: Food Research International, 2012; 496-504.
- Khoubnasabjafari M, Jouyban A A review of phytochemistry and bioactivity of quince (*Cydonia oblonga* Mill.). Journal of Medicinal Plants Research Vol. 2011; 5(16): 3577-3594.
- Hegedüs A, Papp N, Stefanovits-Bányai É. A review of nutritional value and putative health-effects of quince (*Cydonia oblonga* Mill.) fruit.
- Silva BM, Andrade PB, Ferreres F, Seabra MR, Beatriz M, Oliveira PP, Ferreira AM. Composition of Quince (*Cydonia oblonga* Miller) seeds: phenolics, organic acids and free amino acids. Natural Product Research: Formerly Natural Product Letters, 2001; 275-281. DOI: 10.1080/14786410410001714678.
- Minaiyan, M, Ghannadi A, Etemad M, Mahzouni P. A study of the effects of *Cydonia oblonga* Miller (Quince) on TNBS-induced ulcerative colitis in rats.

- Research in Pharmaceutical Sciences 2012; 7(2): 103–110.
22. Carvalho M, Silva BM, Silva R, Valenta P, Andrade PB, Bastos ML. First Report on *Cydonia oblonga* Miller Anticancer Potential: Differential Antiproliferative Effect against Human Kidney and Colon Cancer Cells. *Journal of agricultural and Food Chemistry*, 2010; 3366–3370. DOI: 10.1021/jf903836k.
 23. Chebbi IR, Haoues M, Essafi M, Zakraoui O, Fattouch S, Karoui H, Essafi, Benkhadir K. Quince peel polyphenolic extract blocks human colon adenocarcinoma LS174 cell growth and potentiates fluorouracil efficacy. *Cancer Cell International*, 2011; 24(4): 2-15.
 24. Ahmed M, Bastawy S. Evaluation of anti-inflammatory properties and possible mechanism of action of Egyptian quince (*cydonia oblonga*) leaf. *The Egyptian Journal of Biochemistry & Molecular Biology*, 2014; 109-205.
 25. Shinomiya F, Hamazu Y, Kawahara T. Anti-allergic effect of a hot-water extract of quince (*Cydonia oblonga*). *Bioscience, Biotechnology, Biochemistry*, 2009; 1773–1778. doi: 10.1271/bbb.90130.
 26. Kawahara T, Lizuka T. Inhibitory effect of hot-water extract of quince (*Cydonia oblonga*) on immunoglobulin E-dependent late-phase immune reactions of mast cells. *Cytotechnology*, 2011; 143–152. doi: 10.1007/s10616-0109323-8.
 27. Hoffmann A, Klein SD, Grundemann C, Garcia-Kaufner M, Wolf U, Huber R. Efficacy of nasal spray from citrus lemon and *Cydonia oblonga* for the treatment of hay fever symptoms-A randomized, placebo controlled cross over study. *Phytotherapy Research*, 2016; 10.1002/ptr.5649.
 28. Fattouch S, Caboni P, Coroneo V, Tuberoso CIG, Angioni A, Dessi S, Marzouki N, Cabras P. Antimicrobial Activity of Tunisian Quince (*Cydonia oblonga* Miller) Pulp and Peel Polyphenolic Extracts. *J. Agricultural and Food Chemistry*, 2007; 963-969.
 29. Zhoua W, Abdusalama E, Ablizb P, Reyimc N, Tiand S, Ajia Q, Issaka M, Iskandara G, Moore N, UmarA. Effect of *Cydonia oblonga* Mill. fruit and leaf extracts on blood pressure and blood rheology in renal hypertensive rats. *J. Ethnopharmacology* 2014; 464-469.
 30. Zhoua W, Abdurahmana A, Umar A, Iskander G, Abdusalama E, Berkéb B, Bégaudb B, Moore N. Effects of *Cydonia oblonga* Miller extracts on blood hemostasis, coagulation and fibrinolysis in mice and experimental thrombosis in rats. *J. Ethnopharmacology*, 2014; 163-169. doi.org/10.1016/j.jep.2014.03.056.
 31. Magalhães AS, Branca M, Silva BM, Pereirac JA, Andrade PB, Valentãob P, Carvalhoa M. Protective effect of quince (*Cydonia oblonga* Miller) fruit against oxidative hemolysis of human erythrocytes. *J. Food and Chemical Toxicology*, 2009; 1372-1377. doi:10.1016/j.fct.2009.03.017.
 32. Benzarti S, Hamdi H, Lahmayer I, Toumi W, Kerkeni A, Belkadhi K, Sebei H. Total phenolic compounds and antioxidant potential of quince (*Cydonia oblonga* Miller) leaf methanol extract. *International Journal of Innovation and Applied Studies*, 2015; 518-526.
 33. Silva BM, Andrade PB, Valentao V, Ferreres F, Seabra RM, Ferreira MA. Quince (*Cydonia oblonga* Miller) Fruit (Pulp, Peel and Seed) and Jam: Antioxidant Activity. *J. Agricultural and Food Chemistry*, 2004; 4705–4712.
 34. Aslan M, Orhan N, Orhan DD, Ergun F. Hypoglycemic activity and antioxidant potential of some medicinal plants traditionally used in Turkey for diabetes. *J. Ethnopharmacology*, 2010; 384–389; doi: 10.1016/j.jep.2010. 01.040.
 35. Mirmohammadlu M, Hosseinib SH, Kamalinejad M., Gavganid ME, Noubarania M, Eskandaria MR. Hypolipidemic, Hepatoprotective and Renoprotective Effects of *Cydonia Oblonga* Mill. Fruit in Streptozotocin-Induced Diabetic Rats. *Iranian Journal of Pharmaceutical Research*, 2015; 1207-1214.
 36. Tamri P, Hemmati A, Boroujerdnia MG. Wound healing properties of quince seed mucilage: in vivo evaluation in rabbit full-thickness wound model. *International journal of surgery*, 2014; 843-847. doi.org/10.1016/j.ijsu.2014.06.016.
 37. Sabir, Qureshi R, Arshad M, Amjad MS, Fatima S, Masood M, Saboon, Chaudhari SK. Pharmacognostic and clinical aspects of *Cydonia oblonga*: A review. *Asian Pacific Journal of Tropical Disease*, 2015; 850-855; doi: 10.1016/S2222-1808(15)60934-3.