



## *Cydonia oblonga* miller: An update review of its ethno pharmacology

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### Abstract

Historic documents present evidences of Quince domestication in the Mesopotamia, between 5000 and 4000 BC that have been pursued to about 500 BC in the ancient Persian and Greek empires. By the end of nineteenth century, domesticated populations of this plant had been spread to the West and East Asia, Europe and America which in turn, created several centers of diversity along its distribution route in some regions such as plateau of Iran, Anatolia, Greece and Southern Europe, north of the Black Sea and Russia. *Cydonia oblonga* Miller (*C. oblonga*) is considered as an important medicinal plant throughout the world. It is native to Mediterranean region and Central Asia having a long term history of medicinal and ethnobotanical use. *C. oblonga* is well known for its anti-diabetic, anti-oxidant, anti-microbial, anti-allergic, anti-hemolytic, aphrodisiac and UV-protectant activity. It is a good and low cost natural source of metabolites with interesting biological properties. Extensive research has been performed on the metabolic profile and biological potential of this species. In particular, quinces leaves reveal to constitute a promising natural source of bioactive phytochemicals and are suitable for application in nutritional/pharmaceutical fields. Mostly it is grown for fruit and also serves as rootstock for pear. This paper gives an overview of scientific literature available on plant *C. oblonga*. This knowledge about the medicinal plants usage can also be extended to other fields like field of pharmacology. In view of the nature of the plant, more research work can be done on humans so that a drug with multifarious effects will be available in the future market.

**Keywords:** *Cydonia oblonga* miller, quince, rosaceae, aphrodisiac activity

### Introduction

Three quarters of the world population rely on herbal and traditional medicine as a basis for primary health care. Herbs and herb-derived medicines have played a crucial role in health and disease management for many centuries. Many ancient civilizations show documented evidence for the use of herbs in the treatment of different ailments; as was seen with Mesopotamian, Indian Ayurveda, Ancient Traditional Chinese medicine and Greek Unani medicine. The global demand for herbal medicinal products has increased significantly in recent years.

Plants are not only a dietary source for both human beings and animals but also safer phytomedicines. Traditionally, phytomedicines have been used to treat various ailments in Unani-tibb, Chinese, and Ayurvedic systems of therapies. This curing potential of plants can be supported by numerous scientific evidences. In response to new challenges in health care, researchers are focusing plants to isolate active phytochemicals. The reliability on phytomedicines for treatment of different disorders is greater in present era than never before. In traditional Indian folk medicines, more than 25,000 plant based drug formulations have been documented.

During the recent years, a modest number of studies have investigated the efficacy of traditional herbal medicines using modern methodology and favourable outcomes have been achieved raising the possibility for the revival of herbal remedies. *Cydonia oblonga* Miller, known as Quince, a plant of family Rosaceae is conventionally popular for its medicinal, nutritional,

and ornamental uses. *Cydonia oblonga* is medicinal plant of family Rosaceae which has attracted the researchers owing to its folk medicinal uses and high-valued bioactive. Besides pharmaceutical attributes, the plant is also popular because of renoprotective, hepatoprotective, anti-diabetic, anti-proliferative, anti-hemolytic, anti-inflammatory, anti-allergic, genoprotective, and cardioprotective activities. Protective effect of its leaves on male fertility has been established. Hence, there is immense need to isolate potential bio-actives from Quince for the development of new safer and economical drugs.

### Historical background

The name of the *Cydonia* genus is derived from the name of a region Kydonia in the north-western Coast of Crete Greece, where this tree has been cultivated since the ancient times. It is believed that the quinces were the "golden apples" of Hesperides featured in the eleventh labour of Hercules, and it's also the fruit that was offered to Aphrodite the goddess of love, by Paris, prince of Troy, to gain her favour for provoking the Trojan War. In England, the quinces were first reported in about 1275, the time when King Edward I had some plantations at the Tower of London and they are still grown productively in Scotland. In older Greek ritual these fruits were offered in wedding as they symbolized fertility. During olden times, quince was spread from wild centre of origin to the countries which adjoined the Himalaya Mountains to the east and all through Europe to the west. The United States Department of Agriculture funded plant

collecting expeditions to Azerbaijan, Armenia and Georgia returned with quince seeds and cuttings from all these countries and the availability of *Cydonia* germplasm in the United States increased considerably from 2002 to 2006 as a result of all these collections.

### Geographical distribution

*Cydonia oblonga* Miller (Quince) (*C. oblonga*) belonging to family Rosaceae is most likely originated from the Caucasian area (Western and Eastern Ante-Caucasus, Daghestan, Eastern and Southern Transcaucasia, Talysh) and spread to the Greece, Middle East and around the Mediterranean and Central Asia (Kopetdagh The ravine of Aydere). However the distribution of wild-growing quince in other areas of Central Asia has not been proven. It also grows in Iran, Turkey, Afghanistan and Pakistan. Now this species is widespread, due to cultivated forms, and it is naturalized over almost entire Mediterranean region. Quince also has been cultivated in the north European Baltic countries for its fruit production. As far as the world yield of quince fruits is concerned among all countries, Turkey is the largest producer followed by China, Iran, Argentina and Morocco.

### Botanical description

It is the sole member of genus *Cydonia*, a multi-stemmed spineless shrub or small tree with tomentose buds, petioles, leaves, and fruit. It is grown and cultivated in grounds or gardens

under warm temperature and grows up to 8 m in height and 5 m width. The bark is smooth and brown approaching to black. The young branches are covered with pale greyish wool, flowers are pink or white, squat fat fruits are bright yellowish and shape ranges from round to pear-like, usually pear-shaped. The fruit is a fragrant, astringent taste pome with large numbers of plano-convex seeds arranged in two vertical rows, acquiring 7–12 cm length, 6-9 cm diameter, with pleasant flavour and aroma. Leaves are ovate to oblong, dusky green above and whitish underneath, about 5 cm across and 6-11 cm long. The solitary white flowers are 4-5 cm across, have 5 petals, 20 or more stamens, 5 styles, an inferior ovary with many ovules and are borne on current season of growth. Bloom time overlaps with that of apples, usually at the beginning of April to mid-April in the central latitudes of the Northern Hemisphere.

### Common names

**English:** Quince

**Hindi:** Bihi

**Arabic:** Sefarjal

**Azari:** Heyva

**Chinese:** Wen po

**German:** Quitte, Quittenbaum

**Turkish:** Ayva

**Persian:** Beh

**Table 1:** Botanical Classification

Kingdom	Plantae
Subkingdom	Tracheobionta
Superdivision	Spermatophyta
Division	Magnoliophyta
Class	Magnoliopsida
Order	Rosales
Family	Rosaceae
Genus	<i>Cydonia</i>
Species	<i>C. oblonga</i>
Binomial Name	<i>Cydonia oblonga</i> Miller

### Cultivation

Quince is a hardy, drought-tolerant shrub which adapts to many soils of low to medium pH. It tolerates both shade and sun, but sunlight is required in order to produce larger flowers and ensure fruit ripening. It is an incredibly tough plant that does not require much maintenance, and tolerates years without pruning or major insect and disease problems. Quince is cultivated on all continents in warm-temperate and temperate climates. It requires a cooler period of the year, with temperatures under 7 °C (45 °F), to flower properly. Propagation is done by cuttings or layering; the former method produces better plants, but they take longer to mature than by the latter. Named cultivars are propagated by cuttings or layers grafted on quince rootstock. Propagation by seed is not used commercially. Quince forms thick bushes, which must be pruned and reduced into a single stem in order to grow fruit-bearing trees for commercial use. The tree is self-pollinated, but it produces better yields when cross-pollinated. Fruits are typically left on the tree to ripen fully. In warmer climates, it may become soft to the point of being edible, but additional ripening may be required in cooler climates. They are harvested in late autumn, before first frosts. Quince is also used as rootstock for

certain pear cultivars. The resultant chimera is called *Pirocydonia danielii*.

In Europe, quinces are commonly grown in central and southern areas where the summers are sufficiently hot for the fruit to fully ripen. They are not grown in large amounts; typically one or two quince trees are grown in a mixed orchard with several apples and other fruit trees. In the 18th-century New England colonies, for example, there was always a quince at the lower corner of the vegetable garden, Ann Leighton notes in records of Portsmouth, New Hampshire and Newburyport, Massachusetts. Charlemagne directed that quinces be planted in well-stocked orchards. Quinces in England are first recorded in about 1275, when Edward I had some planted at the Tower of London.

### Traditional uses

Traditionally, the leaves were used as astringent and antiseptic. Fruits were used as astringent, anti-septic, hepatoprotective, cicatrising, anti-inflammatory; for treatment of diarrhoea, dysentery, hepatic disorders, leucorrhoea, haemoptysis, uterine haemorrhages, and wounds. The seeds of *Cydonia oblonga* were used traditionally as astringent, emollient and for the treatment of

Diarrhea, dysentery, cough, sore throat, bronchitis, intestinal colic and constipation.

### Parts used

The parts of the plant used medicinally were leaves, fruits and seeds.



Fig 1: *Cydonia oblonga* plant



Fig 2: *Cydonia oblonga* leaves



Fig 3: *Cydonia oblonga* fruits



Fig 4: *Cydonia oblonga* stem

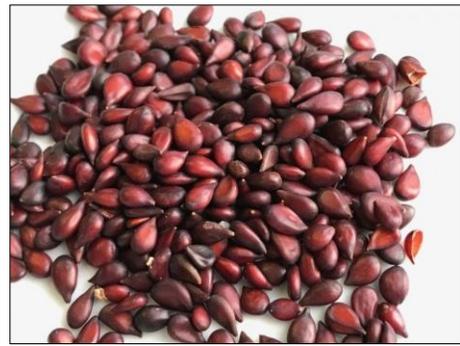


Fig 5: *Cydonia oblonga* seeds



Fig 6: *Cydonia oblonga* flowers

### Phytochemistry

Quince fruit has been extensively consumed as a dietary source. Its fruit is used to prepare jams and jellies. It is also considered an economic and natural source of phenolic compounds.

The organic acid profiling of *C. oblonga* leaves was found to be diverse from seeds, pulps and peels. Different amounts of citric, malic, quinic, shikimic and fumaric acids were fractionated from the fruits and leaves. Ascorbic acid is found only in fruits peels and pulps, absent in seeds. Organic acid profiling of quince jam revealed the organic acid total content to be lower than pulps and peels and greater than that of the seeds. Leaves have relatively higher proportions of quinic acid and are characterized by having lower amounts of shikimic and fumaric acids. In comparison with fruits, leaves contain lower amounts of malic and quinic acids and higher proportions of citric, oxalic, fumaric and shikimic acids. Moreover this matrix has smaller citric and fumaric acids relative percentages and higher malic plus quinic and shikimic acids contents than seeds. Harvesting stages and geographical origin strongly affect the total phenolic and organic acids content in leaves samples. The amount of different organic acids like, such as quinic acid decreases with harvesting time. The substantial influence of geography and harvesting stage on the organic acids profiling of quince leaves focus towards its future use as geographical origin and/or maturity marker.

Quince fruits and leaves contain mono and dicaffeoylquinic acids such as 3-O-caffeoylquinic, 4-O-caffeoylquinic, 5-O-caffeoylquinic, and 3, 5-O-dicaffeoylquinic acids. In both fruits and leaves, quercetin and kaempferol derivatives are present such as quercetin-3-O-galactoside, quercetin-3-O-rutinoside, kaempferol-3-O-rutinoside and kaempferol-3-O-glucoside. Quince peels also contain several quercetin and kaempferol derivatives acylated with *p*-coumaric acid. Quince seed keeps a discrete phenolic profile, composed by numerous C-glycosil

flavones such as lucenin-2, stellarin-2, vicenin-2, isoschaftoside, schaftoside, 6-C-pentosyl-8-C-glucosyl chrysoeriol and 6-C-glucosyl- 8-C-pentosyl chrysoeriol.

Sugars were also testified to be present in quince. Aldobiouronic acids, cellulose and d-xylose were found to be major constituents of seeds and small amount of L-arabinose was also found to be present. The major hydrophilic polysaccharide was a 4-O-methyl-D-glucurono-D-xylan having remarkably greater percentage of glucuronic acid derivatives. The presence of sorbitol and methyl- $\alpha$ -D-galactose was noted in leaves.

Twenty-one different types of free amino acids were recorded in numerous samples of quince fruits which were investigated by using gas chromatography-flame ionization detector analysis. The highest content of free amino acids was detected in peels. Major free amino acids were found to be hydroxyproline, aspartic acid and asparagine. Likewise, in quince jams, major fractions of aspartic acid, asparagine, and glycine or hydroxyproline were recorded.

The essential oil analysis of leaves was carried out at flowering and fruiting stages by gas chromatograph-mass spectrometer analysis. A total of 47 components were identified representing 95.7% oil of quince leaves of flowering stage and 40 representing 64.5% of quince leaves of the fruiting stage. The common main constituents of the essential oil of leaves at flowering period are high percentage of aromatic aldehyde (benzaldehyde 12.8%), followed by fatty acid (hexadecanoic acid 7.2%), oxygenated monoterpene (linalool 5.7%), norisoprenoid ( $\beta$ -lonone 5.1%) and sesquiterpene hydrocarbon (germacrene D 8.6%).

### Toxicity

Quince fruit seeds are dangerous to ingest in case of breast-feeding because the seeds have nitriles, which are commonly present in seeds of the Rosaceae. In stomach, the enzymes and stomach acid both hydrolyze nitriles and ultimately produce hydrogen cyanide. This hydrogen cyanide is a poisonous volatile gas and the seeds are prone to be toxic if excess amount is consumed. Several studies with *C. oblonga* fruits illustrated the presence of cyanogenic glycosides such as amygdalin and prunasin.

### Ethnobotanical uses

Quince plant is used like a resource of liqueur, candies, flavour in marmalade, jelly and brandy and also acts the same as preservative. While raw fruit is not agreeably eatable due to its stiffness, acrimony and astringent property. Therefore, valued for making jam "marmalade" as well as it is used as a supplement to main dishes and for flavouring pies. When production of quince is squat, the jam is simply admixed by addition of apple (*Malus communis* Lamk) because it is inexpensive and its quality is comparable to quince. Nevertheless, this type of adulteration can be identified by the presence of phloretin 2'-glucoside and phloretin xylosyl glucoside both dihydrochalcones are present in apple and these are regarded as chemical markers.

### Ethnopharmacological studies

Researchers have reported that different biological activities of *Cydonia oblonga* in various *in vitro* and *in vivo* test models. These have been highlighted in detail in following headings.

### Aphrodisiac activity

*C. oblonga* is considered as a powerful libido invigorator in Tib-E-Nabvi and Unani System of Medicine. The aphrodisiac activity of the quince hydroalcoholic extract of the fruits has been studied in Wistar rats and the extract was administered orally in the dosage of 500 mg/kg and 800 mg/kg body weight per day for 28 days. After administration of the extract, mounting frequency and the mating performance of the rats improved remarkably.

### UVA protective activity

*C. blonga* leaf extract has potential to be used for defense as well as mitigation of harmful impacts of UVA on a few haematological and biochemical aspects of the reasonably important African catfish, *Clarias gariepinus*. Blood parameters are helpful for the measurement of physiological disorders in stressed fish and consequently offer information about the extent of damage in the fish. The considerable decline ( $P < 0.05$ ) in the red blood cell was detected in the groups exposed to UVA in contrast to the control groups. Exposure to UVA resulted in noticeable red cell shrinkage and increased mean cell hemoglobin concentration and revealed an increase in mean cell volume and mean cell hemoglobin in the blood of the exposed fish compared to the control. A substantial decline ( $P < 0.05$ ) in the total white blood cells was traced in the exposed fish contrast to the control. Methanolic extract of quince leaf (before fruits ripening) used for the mitigation of harmful UVA effected on catfish by preventing hematotoxic stress induced by UVA.

### Healing activity

The healing effect of quince seed mucilage was studied on the skin lesions which were induced by T-2 toxin. The rabbits were divided into five groups. Group 1 received the poison as positive control; Group 2 received eucerin as negative control; Groups 3 to 5 received 5%, 10%, and 15% mucilage treatment, respectively. A solution of T-2 toxin (83 mg/mL) in methanol was prepared and applied on skin twice with 24 h interval. On the 8th day, erythema and inflammation were observed in Groups 1, 2 and 3, but the complete healing of the skin damage treated by 10% and 15% quince seed (Groups 4 and 5) was observed. Normal skin with grown hairs was the consequence of treatment with quince seed mucilage.

### Immunological and anti-allergic effects

The effects of the combined *Citrus medica* ssp. *limonum* *efructibus*/*Cydonia oblonga efructibus* (*Citrus medica* ssp *limonum* and *Cydonia oblonga*: each 0.01 g/ml), and separate products of *Citrus* (0.01 g/ml) and *Cydonia* (0.01 g/ml) were investigated on the immunological pathways involved in seasonal allergic rhinitis (SAR). Peripheral blood mononuclear cells (PBMCs) from five healthy and five grass pollen allergic donors were isolated and analyzed *in vitro* after polyclonal and allergen-specific stimulation of T cells in the presence of the three extracts. The analyses demonstrated acceptable cell survival with no signs of toxicity. Citrus mainly had a selective effect on reducing allergen-specific chronic inflammatory (TNF- $\alpha$ ; Citrus compared to *Cydonia* and *Citrus/Cydonia*: -87.4 ( $p < 0.001$ ) and -68.0 ( $p < 0.05$ ), respectively) and Th2 pathway activity (IL-5; Citrus compared to *cydonia*: -217.8 ( $p < 0.01$ ); while, both *cydonia* and

Citrus/cydonia mainly affected the induction of the allergen-specific Th1 pathway (IFN- $\gamma$ ; Cydonia and citrus/cydonia compared to citrus: 3.8 ( $p < 0.01$ ) and 3.0 ( $p < 0.01$ ), respectively). *Citrus* and *Cydonia* demonstrated different working mechanisms in the treatment of SAR and the combination product did not demonstrate larger effects than the separate preparations.

#### Anti-diabetic activity

The anti-diabetic activities of quince leaves hydro-ethanolic extract have been studied along three herbal remedies used in Turkish traditional medicine on normal and streptozocin-induced diabetic rats. There was no noteworthy effect on normal rats after intake of 2g/kg glucose. Though a considerable fall in the blood glucose levels of diabetic rats was reported at a time period of 0 to 3 h, the beneficial effect of the extract (250 or 500mg/kg dried extract) was the same as a standard anti-diabetic drug and there was no noteworthy difference between glucose levels of the extract and tolbutamide treated rats. The antioxidant activity of the quince extract was evaluated by glutathione and thiobarbituric acid reactive substance (TBARS) contents of kidney, liver and heart of diabetic rats. As a result, there was no significant decrease in glutathione contents of diabetic and non-diabetic rats, while significant decreases were observed in TBARS of heart tissue of diabetic rats when equated with diabetic control group. The low dose of quince extract (250mg/kg) revealed a slight and non-significant decrease on kidney TBARS, whereas the higher dose (500mg/kg) showed significant decrease in TBARS content of kidney ( $P < 0.01$ ). So long term use of quince is recommended in type II diabetic patients to protect against the complications of diabetes mellitus.

#### Anti-allergic activity

The anti-allergic properties of hot-water extract of quince fruit were tested *in vivo* and *in vitro*. The release of  $\beta$ -hexosaminidase was decreased considerably after addition of 50, 100 and 200 $\mu$ g/mL of hot-water extract to cell culture. As a result, atopic dermatitis occurred like marks appeared on the face, ear, nose, neck and dorsal skin of mice in control group after three weeks, whereas the severity of the signs in quince treated mice were significantly low. The immunoglobulin E levels of control and quince treated animals with 5% hot-water quince extract orally were (1 635  $\pm$  289) and (994  $\pm$  205) ng/mL, respectively, in which the variation was statistically significant ( $P < 0.01$ ).

#### Anti-microbial, anti-bacterial and anti-fungal effects

The resistance of microorganisms to anti-biotics urges the researchers to discover new phytomedicines from plants which have been used traditionally for curing different ailments. In one such attempt regarding a common pathogenic bacterial strain, the *in vitro* anti-*Helicobacter pylori* activity of 33 substances, juices and plant extracts and 35 of their combinations including Quince juice (10%) were tested using an agar diffusion method on Columbia blood agar media (ZOI 11 mm). A synergistic effect in antibacterial activity of Quince juice was observed with bilberry, cranberry juice, black choke berry, red currant juice, green tea, and sweet flag rhizome. Quince juice demonstrated the strongest anti-*H. pylori* activity followed by cranberry juice. Acetone and aqueous extracts of Quince fruit peel and pulp depicted antimicrobial activity due to presence of chlorogenic acid 5-*O*-caffeoylquinic along with other phenolic components. Quince

peel extract was the most active one and showed significant decrease in bacteria growth with minimum inhibitory and bactericide concentrations in the range of 102-5 x 103 $\mu$ g polyphenol/ml. It appeared that chlorogenic acid is regarded as the major component acting in synergism with other components of the extracts to exhibit their total antimicrobial activities. Anti-influenza viral activities of Quince fruits phenolic extract was also studied and showed on the haemagglutination inhibition test.

#### Anti-diarrheal effect

Aqueous-methanolic of seeds was studied for its spasmolytic/spasmodic activity in isolated rabbit jejunum and guinea pig ileum. It was observed that seeds extract produced slight prokinetic effect at lower concentrations (0.003–0.03 mg/mL) with EC50-value (0.73 mg/mL) and induced muscle relaxation. Moreover, the extract successfully eliminated the KCl induced smooth muscle spasm in rabbit jejunum (EC50 0.86 mg/mL) similar to that of verapamil, a calcium channel blocker. The plant extract also induced atropine sensitive spasmodic effect on isolated ileum of guinea-pig at concentration of 1–10 mg/mL which is about 31.22  $\pm$  3.7% of control, acetyl choline (0.3  $\mu$ M). This spasmodic effect is attributed to activation of muscarinic receptors, in the gut by the extract like that of acetyl choline. Thus, Quince extract contains spasmodic constituents that relieve constipation. However, plant extract is needed in slightly higher concentration (1–10mg/mL) for spasmodic effect than spasmolytic action.

#### Anti-inflammatory effect

The anti-inflammatory effect of polyphenolic extract from the Tunisian Quince was investigated. Lipopolysaccharide (LPS) treatment of human THP-1-derived macrophages stimulated secretion of the pro-inflammatory cytokine TNF- $\alpha$  and chemokine IL-8. Quince peel polyphenolic extract inhibited these changes in a dose-dependent manner. Concomitantly, Quince polyphenols enhanced the level of the anti-inflammatory cytokine IL-10 as well as IL-6 secreted by LPS-treated macrophages. The increase in IL-6 secretion that occurred when Quince polyphenols were associated with LPS treatment was partially responsible for the polyphenols-mediated inhibition of TNF- $\alpha$  secretion. Biochemical analysis showed that Quince polyphenols extract inhibited the LPS-mediated activation of three major cellular pro-inflammatory effectors, nuclear factor-kappa B (NF- $\kappa$ B), p38MAPK and Akt.

#### Anti-oxidant effect

The antioxidant activity of quince fruit (pulp, peel, and seed) and jam, methanolic extracts were fractionated into a phenolic fraction and an organic acid fraction and were analyzed by high-performance liquid chromatography/diode array detection and HPLC/UV. Antiradical activities of the extracts and fractions were evaluated by a microassay using 1,1'-diphenyl 2-picrylhydrazyl. The phenolic fraction exhibited a stronger antioxidant activity than the whole methanolic extract. Organic acid extracts were the weakest in terms of anti-radical activity, which indicated that the phenolic fraction gave a higher contribution for the anti-oxidant potential of quince fruit and jam. The evaluation of the antioxidant activity of methanolic extracts showed that peel extract exerted the highest anti-oxidant capacity. The IC50 values of quince pulp, peel, and jam extracts

were correlated with the caffeoylquinic acids content. Among the phenolic fractions, the seed extract was the one that exhibited the strongest anti-oxidant activity.

#### **Anti-ulcerative colitis effect**

Rats were grouped (n=6) and fasted for 36 h before colitis induction. TNBS was instilled into the colon with a hydroalcoholic carrier and then treatments were made for 5 days starting 6 h after colitis induction 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. Data suggest that QJ and QHE were effective to diminish inflammation and ulcer indices in this murine model of acute colitis.

#### **Anti-hypertensive activity**

60 hypertensive rats were randomly divided into 6 groups as model, captopril control, *Cydonia oblonga* Mill. high, medium and low three-doses, and sham operation for 8 weeks. Blood pressure of rats was measured every two weeks. They found that the *Cydonia oblonga* Mill. and captopril groups were significantly lower than ( $P < 0.05$ ) the model group; and the Ang levels in *Cydonia oblonga* Mill high, medium and low dose group in renal tissue were lower than the model group ( $P < 0.05$ ).

#### **Anti-cancer effect**

The extracts from quince leaf showed concentration-dependent growth inhibitory activity towards human colon cancer cells, while no effect was observed in renal adenocarcinoma cells. Concerning the fruit, seed extracts exhibited no effect on colon cancer cell growth, whereas strong anti-proliferative efficiency against renal cancer cells was observed for the highest concentration assayed.

#### **Kidney protecting effect**

Eleven adult New Zealand white male rabbits were randomly divided into three groups and they were kept under constant laboratory conditions with respect to humidity, illumination and temperature for two weeks prior to the study. Group 1 received a cholesterol-enriched diet. Group 2 received a cholesterol-enriched diet plus *C. oblonga* leaf decoction as drinking supplement and the Group 3 received a regular diet without cholesterol enhancement or quince leaf decoction. The results showed that cholesterol-fed rabbits had both glomerular and tubular injuries, while the basement membrane was intact. Cholesterol-fed animals treated with the quince leaf decoction supplement exhibited milder glomerular and tubular injuries. It is therefore plausible that quince leaf has a protective effect on the kidneys. It is concluded that the probable protective effects of quince leaf decoction on the hypercholesterolemia induced renal injury might be attributed to both its antioxidants and lipid lowering effects.

#### **Anti-atherosclerotic activity**

24 male rabbits were randomly divided into normal diet (n= 6) and high cholesterol diet (n= 18) groups. 8 weeks later all the normal rabbits and 3 of high cholesterol rabbits were killed and observed plaque formation in the aorta. The reminders of high cholesterol diet rabbits were divided into 3 groups (1-control, 2-atorvastatin 0.5mg/kg, 3-quince leaf extract 50mg/kg). At the end

of third month the blood samples of all three groups were collected and the biochemical parameters were determined. The results showed that there is no significant difference between atorvastatin and quince extract groups revealing that the lipid lowering activity of quince extract is the same as that of atorvastatin.

#### **Anti-spasmodic effect**

Rabbits (1000-1500g) and Guinea-pigs (500-600g) of both sexes and local breed were kept, and maintained at standard environmental conditions. The animals were given the crude extract of *Cydonia oblonga* seeds and liberated access to tap water as per routine, but were kept on fasting for 1 day following the start of experiment. The results were compared with the effect of verapamil as a standard  $Ca^{++}$  antagonist. Results showed that the crude extract of *Cydonia oblonga* seeds produced atropine sensitive spasmodic effects in isolated ileum of guinea-pig and rabbit jejunum preparations. They concluded as the mild spasmodic property of the *Cydonia oblonga* seed extract is caused by the activation of muscarinic receptors, while  $Ca^{++}$  antagonist mechanism is possibly responsible for its anti-spasmodic actions seen in gut and tracheal tissues.

#### **Hypolipidemic and Hepatoprotective effects**

Randomly divided the seventy healthy rats into 6 groups as normal controls, model controls, simvastatin and low, medium and high dose. *Cydonia oblonga* Mill. leaf extracts, orally for 56 days. The normal controls were fed with a normal diet and all other groups were with a high fat diet. Rat weights were recorded over time. Lipid profiles as well as AST, ALT and total protein (TP) were measured in the serum after 56 days. They found that the effect of COM was similar to that of simvastatin except lipoprotein lipase and hepatic lipase, which were reduced by COM but not by simvastatin. *Cydonia oblonga* Mill. leaf extracts have hypolipidemic and hepatoprotective effects, probably related to increasing antioxidant capacity and lipoprotein metabolism in the liver, and inhibition of lipogenesis.

#### **Alpha-amylase inhibitory effect**

The extract of the unripe fruit of quince (*Cydonia oblonga* Miller) possesses several biological active components including sorbitol, quinic acid, *p*-vinylphenol and cyclopropane carboxylic acid. The last two components might be implicated in alpha amylase inhibition. This privilege for this extract herein reflects a great potentiality for application of such extract in food and drug products, with remarkable benefits for human health.

#### **Clinical study**

A randomized single blinded placebo controlled study was conducted to evaluate the effects of combined Unani formulations in allergic rhinitis (Nazla Haar) with special reference to the eosinophils in nasal smear. Forty subjects diagnosed with allergic rhinitis were selected and randomly divided into two groups as test group was obtained the decoction of *Cydonia oblonga*, *Ziziphus jujuba*, *Cordia dichotoma* with syrup of *viola odorata* and the placebo controlled group was obtained sugar syrup orally. The effect of the study was assessed based on the subjective parameters (rhinorrhoea, sneezing, nasal congestion, itchy nose, mouth or throat, lacrimation, post nasal drip and headache) in three follow ups and the objective

parameter nasal smear for eosinophils (NSFE) at baseline and at the end of the treatment. The test group showed a significant improvement in reducing the number of eosinophils in allergic rhinitis patients as compared to the placebo group.

### Conclusion

*C. oblonga* belonging to family Rosaceae is most likely originated from the Caucasian area (Dagestan, Talysh, Eastern and Southern Transcaucasia, Western and Eastern Antecaucasus) and spread to Greece, Middle East and around the Mediterranean and Central Asia. However the presence of wild growing quince in other areas of Central Asia has not been verified yet. *C. oblonga* is well known for its anti-diabetic, anti-oxidant, anti-microbial, anti-allergic, anti-hemolytic, aphrodisiac and UV-protectant activity. This plant is an excellent and inexpensive natural resource of metabolites with remarkable biological properties. It possesses great medicinal and ethnobotanical uses. Jams and jellies are made from its fruits. Still more research is required to evaluate its medicinal potential and its conservation also needed because it is an economically important plant. This plant is an excellent and inexpensive natural resource of metabolites with remarkable biological properties which possesses significant medicinal and ethnobotanical uses. Whereas, chemical and synthetic compounds have many demerits and side effects, more clinical researches are needed to explore its medicinal effects in order to introduce its different compounds as standard drugs for various disorders and diseases.

### Author contribution

All authors listed have significantly contributed to the development and the writing of this article the writing of this article.

### Conflict of interest statement

The authors declare no conflict of interest.

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