Review Article

Lokāt (*Eriobotrya japonica*): A fruit with nutritional and medicinal properties, in the light of Unani Medicine and recent scientific studies

ABSTRACT

Eriobotrya japonica Lind. named as *loquat*, is a subtropical fruit of the family Rosacea which is well known medicinal plant originated in Japan and China. Various parts, like leaves, peels and fruits have been shown to possess various useful health effects. In Unani medicine, it is vastly utilized in many illnesses, like Fevers, Nausea, De-arranged sanguinous humour, Indigestion, Liver diseases, Vomiting, Dysentery, Wounds, inflammations etc. Loquat plant contains many active constituents, such as carotenoids, vitamins, polyphenolic compounds and others. According to various pharmacological studies it is found that the plant has many biological effects like anti-tumor, anti-diabetic, anti-inflammatory, anti-mutagenic, antioxidant, antiviral, antitussive, hepatoprotective and hypolipidemic activity. This review aims to shed light on the therapeutic applications of *loquat* based on both traditional Unani literature and scientific studies conducted on different parts of the plant.

1. INTRODUCTION

Eriobotrya japonica (Thunb.) Lindl. is a fruit tree of medium sized that belongs to the family Rosacea. It is usually named Loquat. It has been implanted for more than two thousands years, and is native to Japan and China but has recently implanted commercially worldwide in over 30 countries, such as Japan, Iraq, Turkey, Spain, Italy, Syria, and others. [1,2]. The history of loquat cultivation is more than 2000 years old, dating from the Chinese Han dynasty (100 B.C.) [3]. “Loquat” is commonly known as “*Lokāt*” in Unani Medicine. It attains up to 6 meters or more in height, with thick and evergreen oval-oblong leaves. Fruit is yellow to orange, pear-shaped, with seeds 3 to 4 cm long, and sweet taste [1,2]. Among other fruits, unusually loquat flowers in early winter or autumn, and its fruit ripens in early spring or late winter [4]. Currently, loquat has been utilized in jam, chutney, and jelly preparation, in addition to being eaten as a fresh fruit [5]. Loquat is implanted mostly for fruit production, and in the Unani medicine, it has also been utilized for various medicinal purposes like nausea, vomiting, humour, digestion, liver diseases, dysentery, wounds, inflammations etc. Based on pharmacological studies, both OA and UA have been proven to have bioactivities such as anti-inflammatory, diuretic, anti-tumor [6], hepatoprotective [7], and anti-HIV. [8]

2. METHODOLOGY

A comprehensive literature review was conducted by searching all available classical textbooks using key terms such as Lokāt, in the context of Unani medicine. Additionally, electronic databases including Research Gate, Google Scholar, and PubMed were explored using keywords like *Eriobotrya japonica*, *Lokāt*, Loquat, Unani Medicine, etc. The search included both classical Unani terms and botanical nomenclature. Review articles and experimental studies were carefully considered for data collection and subsequent analysis. This meticulous approach aimed to gather relevant information from both traditional Unani sources and contemporary scientific literature, providing a comprehensive overview of the therapeutic applications and properties associated with *Eriobotrya japonica* in the context of Unani medicine.

3. Observations

3.1 Distribution

Eriobotrya japonica Lindl. is widely refined in subtropical regions of China, Japan, India, and the Mediterranean area [10[. In India it grows in Kashmir and Bengal. [9]

3.2 Botanical description:

Eriobotrya japonica Lindl. is a large, evergreen shrub or small tree with a rounded crown, a short trunk, and woolly new twigs. The tree can grow to 5–10 meters (16–33 feet) tall but is often smaller, about 3–4 m (10–13 ft). It is unusual among fruit trees in that the flowers appear in the autumn or early winter, and the fruits are ripe at any time from early spring to early summer.The color of loquat fruit shows a marked change from green to yellow during development and maturation and from yellow to deep orange during ripening. The leaves are alternate, simple, 10–25 cm (4–10 inches) long, dark green, tough, and leathery in texture, with a serrated margin. The flowers are 2 cm (3/4 in) in diameter, white, with five petals, and produced in stiff panicles of three to ten flowers. The flowers have a sweet, heady aroma that can be smelled from a distance.The fruit begins to ripen from spring to summer, depending on the temperature in the area. [11]

3.3 Scientific classification

Kingdom:	Plantae
Division:	Tracheophyta
Class:	Magnoliopsida
Order:	Rosales
Family:	Rosaceae
Genus:	Eriobotrya
Species:	*Eriobotrya japonica* (Thunb.)
Synonyms:	*Mespilus japonica*, *Photinia japonica*, *Foliumeriobotrriya*. [3]

Fig 1. Lokāt tree ***a, b,*** tree with flowers & dried leaves ***c, d***, fruits ***e, f*** and seeds***g***.

3.4 Description in Unani Literature:

Lokāt is a tree introduced in India by English people. It reached to a height of *Qalmī Ām* (mango tree). Leaves are big with dentate margins; fruits and flowers appear in clusters. The fruits are green when unripe and yellow when ripened. The size of the fruit is a pigeon's egg. Unripe fruits are citrus in taste, and ripe fruits are sweat in the teste. Fruits have 4-5 seeds which look like the seeds of *Sharīfa* (*Annona squamosa* L.) or *Khīrnī* (*Mimosops elengi* L.) seeds, but are larger in comparison. [9]

***3.5 Mutarādifāt* (vernacular names):**

Urdu:	Lakhota
Hindi:	Lukat, Logat, Latku
English:	Loquat
Kashmiri:	Lokāt
Bengali:	Lakhot
Sanskrit:	Luttak
Kannad:	Lakkote
Marathi:	Lokat
Gujrati:	Logat
Tamil:	Alakota
Malayalam:	Nespali
English:	Loquat

***3.6 Mizāj* (temperament):**

Cold and dry and some says cold and moist. [12]

***3.7 Af'ālwaKhawās* (actions and uses):**

Qāti'-i-Ṣafrā' (anti-bilious), *Musakkin Ḥiddat-i-Khūn* (blood heat moderator), *Dāfi' Qay'* (antiemetic), *Mufarriḥ* (exhilarant), *Dafi' Ḥumma* [12,13], *Musakkin-i-Atash* (Thirst quencher) [14].

***3.9 Tarkīb-i-Iste'māl* (method of administration)**

***3.9.1 Amrāḍ-i-Ri'a* (*diseases of lungs*)**

- For the treatment of cough, leaves, flowers and fruits of Lokāt are used in the form of decoction in a quantity of 10-20 ml. [9]

***3.9.2 Amrad-i-Nizām-i-Haḍm* (*GIT disorders*)**

- Its fruit is taken to cure indigestion, vomiting, and dysentery.[9] The juice of Lokāt increases appetite and treats indigestion [9].
- The decoction of its leaves is useful for the treatment of liver diseases [9]

3.9.3 Inflammation and wounds

- Powder of its dried leaves, are applied locally to heal wounds. [9]

3.9.4 Dhayābītus

- *Safūf-i-Sandal Dhayābītus wala* is taken with *Ab-i-Lokāt* for the treatment of *Diabetes.* [15]

***3.10 Maḍarrat* (toxicity, side effect or adverse effect):**

Contraindicated for the person having cold and phlegmatic temperament. [13]

***3.11 Musleh* (Corrective):**

Mirch Siyāh (black piper) and Namak (salt) are used as correctives for its side effects. [13]

3.12 Badal (Substitute or Alternative):

Paniyāla (*Flacourtiajangomas* (Lour.) Raeusch.), having similar properties, so recommended as a substitute of Lokāt.[13]

3.13 Miqdār Khūrāk (Dosage):

2-4 pieces are taken therapeutically.[13]

3.14 Compoundformulations: Ab-i-Lokāt

3.15 Phytoconstituents:

A broad range of important phytochemicals have been detected in loquat, like phenols, alkaloids, cardiac glycosides, flavonoids, mucilage, gums, and phytosterols [16]. There are many active compounds present in leaves and fruits that are responsible for various biological activities of the loquat plant [17]. By using high performance liquid chromatography, flavones like quercetin derivatives (likely rutin or similar quercetin glycoside) and hydroxycinnamic acid derivatives like chlorogenic acid along with other pcoumaric acid and caffeic acid derivatives, have been identified in the leaves, fruit, and flower of loquat but chlorogenic acid has been the main phenolic compound [18]. The presence of bioactive and nutritional compounds in various parts of the plant is mentioned in **Table 1**.

Table 1. Showing bioactive and nutritional compounds in different parts of the Lokāt tree.

S.N	Parts of the plant	Bioactive compounds	Nutritional compounds
1	Fruit	Flavonoids, phenols, and others [19]. Caffeic acid, 4-o-caffeoylquinic acid, neochlorogenic acid, and chlorogenic acid, together with 4-hydroxybenzoic acid, protocatechuic acid, coumaric acid, ellagic acid and ferulic acid have been identified the mature fruits of loquat as major phenolic compounds [20].	The fruit contains sugars: levulose and sucrose; citric acid, tartaric acid, succinic acid, cryptoxanthin, β-carotene, neo-βcarotene. The seeds contain amygdalin and fatty oil, [30], starch [19], Carbohydrates,protein, amino acids [16],Vitamins, carotenoid [19].
2	Kernel	The kernel of loquat is rich with tannins, starch, minerals and proteins [21,22]. Amygdalin, a cyanogenetic glycoside, was found to be present in kernel in considerable amount [23].	
3	Flowers	Flavonoids and phenolic compounds [24]. Oleanolic and ursolic acids (triterpenoid compounds) have been found in the flowers of loquat with different contents based on the type and developmental stage of the cultivar [20]. Volatiles in fresh loquat fruit contain 78 compounds. Among them, 15 compounds significantly contribute to the aroma, and the most potent aroma compound in fresh loquat is phenylacetaldehyde. Additionally, other aroma such as, hexanal, (E)-2-hexenal, hexanoic acid, and β-ionone are also important [25]. The loquat flower extract contains oleanic acid, ursolic acid and amygdalin. [26] Flowers possess a	

		higher content of quercetin and chlorogenic acid derivatives than new and old leaves. [18]	
4	Leaves	Phenolic acids like p-coumaric, gallic, caffeic, ellagic acid, tormentic acid, and flavonoids like quercetin, epicatechin, and catechin [27,28] in addition to tannins, sesquiterpenes, triterpenes and megastigmane glycosides [24,29]. The isomeric pentacyclic oleanolic acid (OA) and ursolic acid (UA) are predominant triterpenoids found in E. japonica leaves [30]. Amygdalin, a cyanogenetic glycoside, was found to be present in loquat leaves in considerable amounts [23]. The new leaves possess higher phenolic and caffeic acid derivative contents than flowers and old leaves. [18]	
5	Stem	Four flavonoids, kaempferol 3-O-β-glucoside, quercetin, quercetin 3-O-α-rhamnoside, naringenin, and three triterpene acids, ursolic, corosolic, and oleanolic acids, were the bioactive components of the stems of *E. japonica* [24].	
6	Stem bark	Catechin, β-sitosterol, oleanolic acid, cinchonain IIb, β-sitosterol-3-O-β-D-glucopyranoside, lyoniresinol, and lyoniresinol 2-a-O-β-Dxylopyranoside are identified and separated from loquat stem barks [1].	

3.16 Pharmacological Studies

3.16.1 Cytotoxic activity

Loquat juice contains active constituents such as terpenoids, phenols, tannins, and flavonoids that have the ability to affect cells. Studying the anticancer effect of loquat juice on cell lines of cancer demonstrated the highest cell line sensitivity by stimulating some glutathione-S-transferase enzymes (GSTs) by many compounds, mainly the polyphenolic compounds in plant extract. The GSTs are considered antioxidants, and by inducing their combination with reduced glutathione, they cause cellular detoxification and lead to the cancer cell toward death and apoptosis [32]. So the utilization of *E. japonica* fruit juice to protect the body of humans against cancer and free radicals is better than use of extraction methods, in which some effective compounds will be lost during the process of extraction and the poisonous solvent will be get rid off. Alwash (2017) reported that the fruit juice of loquat showed a significant anticancer effect on two cell lines of cancer, rhabdomyosarcoma (RD) and human cervical cancer (Hela) cell. But the cytotoxic effect of fruit juice was higher on Hela than on RD cell line, while on rat embryogenic fibroblast (as a normal cell), the effect of juice was lower than on the RD and Hela cancer cell lines [2]. The ethanol and aqueous leaf extracts of *E. japonica* suppressed 7, 12-dimethylbenz[α]anthracene-stimulated breast cancer and inhibited the cancer development of breast by inhibiting the cancer cells proliferation and initiation in rats. But water extracts displayed a higher anticancer activity [33]. Four triterpenic acids, ursolic ,betulinic, δoleanolic, and 3-O-(E)-p-coumaroyl tormentic acid separated from methanol loquat leaf extract exerted cytotoxic effect on human HL60 cells and also shown potent inhibition of DNA topoisomerase I. In HL60 line, 3-O-(E)-p-coumaroyl tormentic acid stimulated apoptotic death of cell mainly through the mitochondrial pathway, considered as key substance for human leukemia therapy [34]. In Meth-A-fibrosarcoma-bearing mice, aqueous extracts of loquat (by hot method) also exhibited anticancer effect through immunomodulatory effect, as specified by factors like interleukin-17, interferon-gamma, and transforming growth factor beta 1 [35]. The ethyl acetate fraction of leaf [36] and the methanol extracts of seed and leaf of loquat (by maceration, 48h) [37] displayed anti-metastatic effects by suppressing the invasion and migration of B16F10 melanoma cells and MDA-MB-231 human cancer cells of breast that were partly by suppressed the matrix metalloproteinase-9 (MMP-9) and also MMP-2 [36,37]. 2α-hydroxyursolic acid and ursolic acid separated from the ethyl acetate E. japonica extracts significantly prevent MMP-9 and MMP-2 effects and considered as key active compounds [36].

3.16.2 Anti-Diabetic activity

Shafi et al. reported (2019) that in streptozotocin in a- induced diabetic rat, the ethanol loquat fruit extract (by maceration, 48h) shown good anti-diabetic effect. [38] Combination of summer-harvested leaf of green tea and leaf of loquat produced a new fermented tea product. In maltose-loaded Sprague–Dawley rats, this product exhibited a reduction of blood levels of glucose and a corresponding decrease in serum secretion of insulin [39]. Aqueous leaf extracts of loquat led to attenuate the elevation in serum glucose, triglyceride, and total cholesterol levels caused by feeding the diet of high cholesterol content in a hypercholesterolemic zebrafish model [40]. The loquat leaf extracts were shown hypoglycemic effects by utilizing the model of high-fat diet stimulated diabetic C57BL/6J mice [41,42]. Ahumada et al. (2017) reported that both methanol flower and leave extracts (by cold method) shown inhibitory impact on both enzymes, suggesting a potential hypoglycemia activity, but flowers extract showed the strongest antihyperglycemic effect because the levels of flavonoids such as quercetin derivatives and levels of chlorogenic acid are higher in flowers than leaves. Loquat fruits extract has not shown an inhibitory impact on α-glucosidase or α-amylase due to the derivatives of quercetin and chlorogenic acid were detected only in flowers and leaves [18]. Toshima et al. (2010) reported that fermented tea products have shown better inhibitory activity against the α-glucosidase enzyme than those formed from fermented tea leaves alone [43] Oboh et al. (2015) exhibited that quercetin derivatives and chlorogenic acid play a significant role on the suppression of α-glucosidase and αamylase enzymes [44].

3.16.3 Effect on kidney function

Diabetes mellitus was known as metabolic disease differentiated by hyperglycemia lead up to several complications, such as retinopathy, neuropathy, angiopathy, nephropathy and others [45]. Shafi et al. (2018) reported that in alloxan stimulated diabetic rats, ethanolic extract (50%) of seeds and fruits of Eriobotrya japonica (by maceration, 48h) displayed renal effect, and this effect was evaluated by estimating the tests of kidney function like levels of serum total proteins, creatinine, and urea. The result reported a nonsignificant elevated serum level of total protein and reduced levels of serum creatinine and urea. The ethanolic extract of loquat fruits has proper effects on levels of serum glucose [46].

3.16.4 Anti-hyperlipidemic activity

Shafi et al. (2019) reported that in streptozotocin a stimulated diabetic rat, the ethanol fruit extract of Eriobotrya japonica (by maceration, 48h) showed significant hypolipidemic activity [46]. In high-fat diet mice, the cell suspension culture of pentacyclic terpenoids ethanol extracts of loquat exhibited hypolipidemic activity because it decreased white adipose tissue (WAT) weights (include visceral fat, mesenteric, perirenal, and epididymal WAT), body weight gain, content of hepatic triacylglycerol, and adipocyte size in the visceral depots [42,43]. Fermented tea product (leaves mixture of both green tea (Camellia sinensis) and loquat) displayed anti-obesity and hypotriacylglycerolemic effects by inhibiting the synthesis of hepatic fatty acids and postprandial hypertriacylglycerolemia through pancreatic lipase inhibition [47]. The aqueous extract of the leaf of loquat exhibited an anti-atherosclerotic effect in a hypercholesterolemic zebra fish model and in cellular assays [40].

3.16.5 Anti-inflammatory activity

Maher et al. study (2015) reported the ethyl acetate -ethanol (1/2) extract and the dichloromethane methanol (0:1) fraction of loquat suppressed the pig secreted phospholipase A2 group IB (pG-IB) and the human secreted phospholipase A2 group IIA (hG-IIA) but CH2Cl2/MeOH 0:1 extract was the better one to suppress especially hG-IIA related to the existence of flavonoid and phenolic compounds [48]. The N-butanol fraction of leaves of loquat demonstrated anti-inflammatory property by inhibiting the expression of nitric oxide synthase and production of NO by attenuating the activation of nuclear factor-κB (NFκB) and also down-regulating cyclooxygenase-2 expression and pro-inflammatory cytokine secretion such as interleukin-6 and tumor necrosis factor-α (TNF-α) in the LPS-activated murine peritoneal macrophage model [36]. Seong et al (2019) reported that in lipopolysaccharide-induced RAW 264.7 macrophage cells, the ethanol loquat leaf extract (by reflux, 4h) has shown an anti-inflammatory effect by suppressing TNF-α production and NO expression [50]. Zar et al. (2013) reported that in lipopolysaccharide-induced RAW 264.7 cells, loquat tea water extract of leaves (by boiling for 15 minutes at 100°C) exerted an anti-inflammatory effect via inhibiting PGE2 and COX-2 production was stimulated by lipopolysaccharide by using ELISA and Western blot assays, respectively. The new bioactive phenolic compounds in loquat tea may be responsible for its anti-inflammatory potency [49]. In mice, the triterpenes the of methanol extract of loquat leaves (by reflux, 3h) inhibited 12-Otetradecanocylphorbol-13-acetate-stimulated inflammation [51]. The total triterpenes decreased the inflammatory cytokine production by suppressing NF-κB stimulation from alveolar macrophages in a chronic bronchitis rat model [52]. In mouse paw edema model [53, 54] macrophage-like RAW 264.7 cells, loquat tea water extract (by boiling for 15 minutes at 100°C) showed inhibitory effects on the expression of TNF-α, interleukin-6, nitric synthase, and NO through the downregulation of pathways of the TGF-β-activated kinase-mediated NF-κB and MAPK [53]. Tormentic acid of ethanol cell suspension extract of loquat may increase the activities of glutathione peroxidase, superoxide dismutase and catalase in the tissue of the liver and decrease paw edema of mice [54] In rat ear, by using a model of dinitrofluorobenzene stimulated allergic dermatitis, ethanol seed extracts (by stirring with a mixer, 1week) of Eriobotrya japonica also displayed in vivo anti-inflammatory activity and inhibited allergic dermatitis development, where improved Th1/Th2 balance and lower serum levels of immunoglobulin E and thickness of ear were shown [55].

3.16.6 Antitussive and expectorant activity

Wu et al. (2018) reported that the ethanol and aqueous extracts of loquat fallen and growing leaves (by hot method, 2h) showed expectorant and antitussive effects. But the ethanol extracts of fallen leaves showed better antitussive effects (relieve cough) that may be related to the higher triterpenoids content of it, like tormentic acid, corosolic acid, maslinic acid, ursolic acid, and others, while aqueous extracts of growing leaves had a higher expectorant effect (reduce airway mucus secretion), which may be due to their higher flavonoid content like quercetin, isoquercitrin, hyperoside, rutin, and others [56] In the aqueous leaf extract of loquat, some of the identified flavonoids show anti-inflammatory effect via NF-κB and signal transducer and activator of transcription 1 inhibition [57]. NF-κB plays an important role in proinflammatory cytokine production. In severe cough cases, inflammation is playing an essential role. In eosinophilic bronchitis, an inflammation of the lower airway can alleviate the sensitivity and severity of coughing [58]. The anti-inflammatory activity of loquat triterpenoids might be due to suppressed signal transduction of MAPK [54,59].

3.16.7 Anti-Melanogenic activity

Seong et al. (2019) stated that ethanol loquat leaf extract (by reflux, 4h) show anti-melanogenic activity through its anti-inflammatory and anti-oxidant activities. Ethanol extract can protect the skin of humans from inflammation and also from oxidative stress, related to the higher content of quercetin and polyphenols that exhibit the inhibition of melanin synthesis. Ethanol extract can regulate production of melanin since melanin plays an important role versus production of UV-stimulated ROS; ethanol extract has shown potent anti-inflammatory and anti-oxidant activities [50,60]. New studies have found that in different inflammatory skin disorders (like dermatitis, eczema), the hyperpigmentation is shown [61,62]. In B16 melanoma cells, the methanol leaf extract of Eriobotrya japonica exerted dose-depending melanogenesis suppression [63]. In addition, 70% and 30% ethanol loquat leaf extracts (by several processes of extraction) inhibited mushroom tyrosinase for whitening effects [64].

3.16.8 Effect on eye and skin

Seong et al. (2019) stated that ethanol loquat leaf extract (by reflux, 4h) did not exert any irritation or induce toxicity in the eye and skin by using animal alternative tests like HET-CAM, BCOP assay (irritation test of the eye) and RHE model (irritation test of the skin) [50]. The aim of the HET-CAM test is to recognize agents that induce irritation of conjunctiva, and the BCOP test is to recognize substances that induce damage to the cornea [65]. Therefore, ethanol extract can be used for skin improvement as a cosmetic ingredient.

3.16.9 Hepatoprotective activity

Shahat et al. (2018) revealed that the methanol extract (80%) of leaves of loquat and its butanol, aqueous, and ethyl acetate fractions displayed hepatoprotective activity in rats with carbon tetrachloride (CCl4)-induced hepatotoxicity [66]. The methanol extract or its fractions administration of this plant significantly reduced biochemical parameter levels in rats like aspartate transaminase (AST), gamma-glutamyl transferase, alanine aminotransferase (ALT), bilirubin, and alkaline phosphate levels but did not influence lipid profiles [66]. The elevation of these enzyme levels specified the loss function of cell membranes and cellular injury [67]. The methanol extract and its fractions also significantly suppressed the CCl4-stimulated increasing level of Malondialdehyde (MDA) which was proved by decreasing in histopathological injuries [66]. MDA, an important CCl4-induced toxicity indicator in rats, is a final product of peroxidation of lipid in the liver [68]. Treatment with CCl4 also increased levels of serum triglyceride, low density lipoprotein, and cholesterol and also decreased levels of high density lipoprotein, which inverted the weakness of the ability of the liver cells to convert cholesterol to bile acid for excretion and to metabolize lipids. The fractions and extract of loquat suppressed these effects [66]. On the endoplasmic reticulum, CCl4 induces disassociation and disruption of polyribosomes that leads to reduced biosynthesis of proteins [69]. Administration of butanol and ethyl acetate fractions significantly suppressed CCl4-stimulated the depletion of total protein and the reduction levels of nonprotein sulfhydryl groups (NP-SH), but aqueous fraction and methanol extract administration did not. Butanol and ethylacetate fractions are more effective in the protection from liver damage than the aqueous fraction and methanol extract [66]. The hydroalcoholic flower extracts of E. japonica (by shaking) shown hepatoprotective activity in mercuric chloride treated rats. By HPLC, phytochemical analysis of hydroalcoholic flower extracts of loquat has indicated that polyphenols like gallic acid and hesperetin as main antioxidants are present [70]. Long-term alcohol consumption may cause alcohol related hepatic disease development. The ethanol stimulated cytochrome P-450 2E1 and caused oxidative stress. The ethanol extracts of loquat leaf (by hot method, 3h) displayed hepatoprotection by reducing the intracellular production of ROS and improving the antioxidant effect in HepG2 cells overproduction cytochrome P-450 2E1. As a result, in manner of concentration-dependent, leaf extract elevated the viability of HepG2 cells and exhibited protective effect in HepG2 cells against ethanol-stimulated toxicity [71]. In rats with non-alcoholic steatohepatitis, ethanol seed extracts of this plant (by stirring with a mixer, 7 days) displayed a protective effect. The ethanol seed extract (70%) strongly suppressed the elevation in the levels of AST, ALT, and fatty droplets forming in the rat's liver. The inhibition of fibrosis and fatty liver may result from increasing activity of antioxidant enzymes which may relieve oxidative stresses [72].

3.16.10 Antimicrobial activity

Rashed et al. (2014) reported that methanol extract (80%) of stems of loquat (by maceration) demonstrated an antimicrobial effect versus strains of fungi and bacteria related to the presence of triterpenes and flavonoids. It was more effective against Candida albicans, indicated that in the treatment of fungal infections, it can be utilized and has no impact on the other strains of fungi and bacteria [24]. Methanol extract of loquat stems due to the presence of flavonoids [73], tannins [74] and also kaempferol 3-O-β-glucoside [75], which exhibited good antioxidant and antimicrobial effects.

3.16.11 Antiosteoporosis activity

Methanol leaf extract of loquat shows antiosteoporosis effect in the model of ovariectomized mice [76]. Ursolic acid was isolated from loquat leaves and displayed an inhibitory effect on osteoclast differentiation, which means inhibited osteoclastogenesis. The elimination of the multinucleated osteoclasts, which contribute to the resorption of bone, is one of the traditional strategies of osteoporosis treatment. Ursolic acid suppresses the differentiation of osteoclast via targeting exportin 5 (XPO5) as nuclear exporter protein [77].

3.16.12 Antifibrosis activity

Triterpenic acids of ethanol extract of leaves of loquat (by cold method, 2h) displayed antifibrosis activity via alleviating fibrosis and improving the structure of the lung in a rat model of bleomycin-induced pulmonary fibrosis. In the macrophages of alveolar of pulmonary fibrosis, the production of TGF-β1and TNF-α both at the level of mRNA and level of protein were decreased in rats. The triterpene acids such as α-hydroxyoleanolic, euscaphic, arjunic, oleanolic, and ursolic acids are present in such loquat extracts [78].

3.16.13 Antioxidant activity

Alwash (2017) reported that E. japonica fruit juice exhibited antioxidant property by using DPPH assays [2]. The juice of the plant has the ability to scavenge DPPH free radicals by donating their H atoms [79,80]. The phenolic compounds, especially flavonoids, which are present in *E. japonica* fruit juice, have the ability to achieve this reaction [17], and are effective as antioxidants rely on position and number of OH groups on the basic flavonoids structure; an antioxidant activity is directly correlated with increasing of hydroxyl group number [1]. Delfanian et al. (2015) reported that the ethanol extract of loquat pulp and the ethanol-water extract of loquat fruit skin (by shaker, 48 h at room temperature) show a higher antioxidant effect in the Rancimat method of β-carotene bleaching and DPPH assay. In stabilization of soybean oil, protective effects of extracts were checked and compared to synthetic antioxidants such as tert-butyl hydroquinone. The treatment of soybean oils with skin extract revealed a stronger antioxidant property than the extract of pulp, but soybean oil containing tert-butyl hydroquinone shows the best protection effect. In general, in soybean oil, extracts of fruit pulp and peel displayed a good antioxidant effect, so to raise the oil shelf life; these can be used for synthetic antioxidants as a substitute [4]. Few studies reported that this effect of its fruits was related to the existence of cyanidine glycosides, derivatives of benzoic and hydroxycinnamic acids [81]. Ahumada et al. (2017) revealed that methanol extracts of loquat flowers and leaves (by cold method) had a higher antioxidant effect and also higher total phenolic contents than extracts of fruit by using 2,2′-azinobis(3-ethylbenzthiazoline-6-sulfonic acid, oxygen radical absorbance capacity (ORAC) and DPPH assay. But the extracts of flowers displayed a better antioxidant effect than that of leaves, indicating that the strong antioxidant effect of flowers is directly correlated to their high quercetin derivatives and chlorogenic acid contents. In addition, higher caffeic acid derivatives contents were likely related to higher values of ORAC. Loquat fruits have lower antioxidant and total phenolic contents than leaves and flowers [18]. Rajalakshmi et al (2017) stated that met hanol fruit and seed extract of loquat (by stirring in a shaker, 38h at room temperature) exhibited antioxidant activity by using scavenging action against superoxide free radicals. But the methanol extract of *E. japonica* seed showed the highest antiradical activity than the extract of fruit [16]. Maher et al. (2015) reported that the ethyl acetate - ethanol (1/2) extract of leaves of loquat displayed an antioxidant effect by using scavenging action against DPPH free radical. But the dichloromethane -methanol (0:1) fraction exhibited a high antioxidant effect, and the rich one on phenolic compounds and flavonoids [48]. Zar et al. (2013) reported that loquat tea (made from roasted leaves of loquat) shows a higher antioxidant effect compared to its fresh leaves by inhibiting cellular ROS and scavenging DPPH. In lipopolysaccharide (LPS)-activated RAW 264.7 cells, loquat tea extract suppressed ROS production. New bioactive phenolic compounds are found in loquat tea are responsible for its antioxidant effects [49]. Rashed et al (2014) stated that methanol stem extract (80%) of loquat (by maceration) demonstrated the excellent antioxidant effect by the TEAC and ORAC assays related to the presence of active constituents as triterpenes like ursoliccorosolic and oleanolic acids and flavonoids like kaempferol 3-O-β-glucoside, quercetin, quercetin, 3-O-αrhamnoside, and naringenin [24]. Ursolic acid that separated from loquat displayed a strong antioxidant effect and good scavenging activity against DPPH radicals at different degrees [82]. Fouedjou et al. (2016) reported that methanol extracts (crude extracts) and their fractions (EtOAc and n-BuOH extracts) and compounds were isolated from *E. japonica* stem bark showed antiradical activity by using ferric (Fe^{3+}) reduction antioxidant power, anti-hemolytic, and DPPH assays, and the most active fraction among them was the EtOAc fraction of *E. japonica*. It can be reported that the antioxidant effect increases with the crude extract fractionation. Amongst the isolated compounds of *E. japonica,*cinchonain IIb catechin lyoniresinol 2-a-O-β-D-xylopyranoside was identified as the most important antioxidant one. [1]

4. CONCLUSION

Lokāt (*Eriobotrya japonica*) emerges as a remarkable fruit with a rich profile of nutritional and medicinal properties, validated by both the ancient wisdom of Unani Medicine and contemporary scientific research. Traditionally, Unani practitioners have long valued Lokāt for its diverse therapeutic applications, including its potential to improve digestive health, support respiratory function, and regulate blood sugar levels. These traditional uses are increasingly supported by modern studies that highlight the fruit's abundance of essential nutrients, antioxidants, and bioactive compounds. Recent scientific investigations have shed light on loquat's capacity to combat oxidative stress, reduce inflammation, and provide protective effects against chronic diseases such as diabetes, cardiovascular ailments, and certain types of cancer. The convergence of Unani Medicine insights with cutting-edge research underscores loquat's potential as a functional food with significant health benefits. As the global interest in natural and holistic health solutions grows, Lokāt stands out as a valuable addition to the repertoire of nutraceuticals. Its integration into modern dietary practices could offer a natural means to enhance health and well-being. Future research should continue to explore and substantiate the therapeutic claims, ensuring a comprehensive understanding of this multifaceted fruit. In conclusion, Lokāt exemplifies the harmonious blend of traditional knowledge and modern science, reaffirming its place as a fruit with profound nutritional and medicinal promise. By embracing both historical perspectives and contemporary findings, we can fully appreciate and harness the potential of Lokāt for improving human health.

CONSENT

Not applicable

ETHICAL APPROVAL (WHEREEVER APPLICABLE)

Not applicable

REFERENCES

1. Fouedjou RT, Nguelefack-Mbuyo EP, Ponou BK, Nguelefack TB, Barboni L and Tapondjou LA. Antioxidant Activities and Chemical Constituents of Extracts from Cordyline fruticosa (L.) A. Chev. (Agavaceae) and Eriobotrya japonica (Thunb) Lindl, (Rosaceae). Pharmacologia, 2016; 7 (2-3): 103-113.
2. Alwash BMJ. Cytotoxic and Antioxidant Activity of Fruit Juice of Eriobotrya Japonica (Thunb.) Lind Plant Cultivated in Iraq.The Iraqi Journal of Agricultural Sciences, 2017; 48(3): 892-898.
3. Chen SJ, Chen MM, Kang BB, Lin YY, Chen QQ. Effect of mechanical injury on postharvest physiology of loquat fruit. Journal of Fujian Agriculture and Forestry University 2003; 33: 250-254.
4. Delfanian M, Kenari RE and Sahari MA. Antioxidant Activity of Loquat (Eriobotrya japonica Lindl.) Fruit Peel and Pulp Extracts in Stabilization of Soybean Oil During Storage Conditions. International Journal of Food Properties, 2015; 18: 2813–2824.
5. Koba K, Matsuoka A, Osada K, Huang YS. Effect of Loquat (Eriobotrya japonica) Extracts on LDL Oxidation. Food Chemistry, 2007; 104(1): 308–316.
6. Shibata S. Chemistry and cancer preventing activities of ginseng saponins and some related triterpenoid compounds. Journal of Korean Medical Science 2001; 16: S28–37.

7. Ma XH, Zhao YC, Yin L, Han DW, Ji CX. Studies on the effect of oleanolic acid on experimental liver injury. Acta Pharmaceutica Sinica 1982; 17: 93–97.
8. Kashiwada Y, Wang HK, Nagao T, Kitanaka S, Yasuda I, Fujioka T, et al. Anti-AIDS agents 30 Anti HIV activity of oleanolic acid, pomolic acid, and structurally related triterpenoids. Journal of Natural Products 1998; 61: 1090–1095.
9. Kalam, MA. Fawakeh Kashmir. New Delhi; Idara Kitabus Shifa. 2021
10. Lin S, Sharpe RH, Janick J, In: Jules, J. (Ed.), Loquat: Botany and Horticulture, Horticultural Reviews, 23. Wiley, New York, 1999, 234–276.
11. Kirtikar and Basu. Indian Medicinal Plants.Periodical Expert Book Agency, New Delhi. Vol II, 2012, p 989-990
12. Ghani, HN. Khazainul Advia. New Delhi; IdāraKitabus Shifa. 2011
13. Hakim, MA. BustanulMufradat. New Delhi; IdāraKitabus Shifa. 2011
14. Kabiruddin HM. Makhzan al-Mufradat. New Delhi: Idara Kitab al-Shifa. 2014, Pp-365-66
15. Khan A. Haziq. New Delhi: Idāra Kitab us Shifa. 2017. P-388-89.
16. Rajalakshmi P, Pugalenthi M, Subashini G, Miss. Kavitha and Vishnukumar S. Nutraceutical studies on Eriobotrya japonica (Thunb.) Lindl. (Fruits & Seeds). International Journal of Advances in Scientific Research, 2017; 3(04):44-48.
17. Matalka KZ, Abdulridha NA, Badr MM, Mansoor K, Qinna NA and Qadan F. Eriobotrya japonica Water extract characterization: an inducer of interferongamma production mainly by the JAK-STAT Pathway. Molecules, 2016; 21: 722.
18. Ahumada J, Fuentealba C, Olaeta JA, Undurraga P, Pedreschi R, Shetty K, Chirinos R, Campos D, and Ranilla LG. Bioactive compounds of loquat (Eriobotrya japonica Lindl.) cv. Golden Nugget and analysis of in vitro functionality for hyperglycemia management. Cien. Inv. Agr. 2017; 44(3): 272- 284.
19. Pareek S, Benkeblia N, Janick J, Cao S and Yahia EM .Postharvest physiology and technology of loquat (Eriobotrya japonica Lindl.) fruit. Journal of the Science of Food and Agriculture, 2014; 94(8):1495-1504.
20. Xu H and Chen J. Commercial quality, major bioactive compound content and antioxidant capacity of 12 cultivars of loquat (Eriobotrya japonica Lindl.) fruits. J. Sci. Food Agric.2011; 91:1057–1063.
21. Fu XM, Kong WB, Peng G, Zhou JY, Azam M, Xu CJ, Grierson D, Chen KS. Plastid structure and carotenogenic gene expression in red- and white-fleshed loquat (Eriobotrya japonica) fruits. J. Exp. Bot. 2012; 63:341–354.
22. Zhang WN, Zhao XY, Sun CD, Li X, Chen KS. Phenolic composition from different loquat (Eriobotrya japonica Lindl.) cultivars grown in China and their antioxidant properties. Molecules. 2015; 20:542–555.
23. Zhuang YF. Determination of amygdalin content in Eriobotrya japonica leaves by high performance liquid chromatography (HPLC). Strait Pharmceutical Journal 2002; 14: 64–65.
24. Rashed KN and Butnariu M. Isolation and antimicrobial and antioxidant evaluation of bioactive compounds from Eriobotrya japonica stems. Adv. Pharmaceut. Bull. 2014; 4 (1): 75-81.
25. Takahashi H, Sumitani H, Inada Y, Mori D, Nakano Y. Potent aroma volatiles in fresh loquat and its canned product. Nippon Shokuhin Kagaku Kogaku Kaishi 2000; 47: 302-310.
26. Kwon HY, Hong SP, Hahn DH, Kim JH. Apoptosis induction of Persicae Semen extract in human promyelocytic leukemia (HL-60) cells. Archives of Pharmacal Research 2003; 26: 157–161.
27. Pande G and Akoh CC. Antioxidant capacity and lipid characterization of six Georgia-grown pomegranate cultivars. J Agric Food Chem. 2009; 57(20):9427–36.
28. Fogo AS, Antonioli E, Calixto JB, and Campos AH. Tormentic acid reduces vascular smooth muscle cell proliferation and survival. European Journal of Pharmacology, 2009; 615(1-3):50–54.
29. Nawrot-Hadzika I, Granicab S, Abela R, Czapor-Irzabekc H and Matkowskia A. Analysis of Antioxidant Polyphenols in Loquat Leaves using HPLC-based Activity Profiling. Natural Product Communications, 2017; 12 (2):163-166.

30. Vasconcelos MA, Royo VA, Ferreira DS, Crotti AE, Andrade E, Silva ML, et al. In vivo analgesic and anti-inflammatory activities of ursolic acid and oleanoic acid from Miconia albicans (Melastomataceae). Zeitschrift fur Naturforschung 2006; 61: 477–482.
31. Park HJ, Yoon SH, Han LS, Zheng LT, Jung KH, Uhm YK, et al. Amygdalin inhibits genes related to cell cycle in SNU-C4 human colon cancer cells. World Journal of Gastroenterology 2005; 11: 5156– 5161.
32. Soni A and Sosa S. Phytochemical analysis and free radical scavenging potential of herbal and medicinal plant extracts. JPP, 2013; 2: 22-29.
33. Kim M, You M, Rhyu D, Jeong K, Kim Y, Baek H, Kim H. Oral administration of loquat suppresses DMBA-induced breast cancer in rats. Food Sci. Biotechnol. 2011; 20:491–497.
34. Kikuchi T, Akazawa H, Tabata K, Manosroi A, Manosroi J, Suzuki T, Akihisa T. 3-O-(E)-pcoumaroyltormentic acid from Eriobotrya japonica leaves induces caspase-dependent apoptotic cell death in human leukemia cell line. Chem. Pharm. Bull. 2011; 59:378–381.
35. Alshaker HA, Qinna NA, Qadan F, Bustami M, Matalka KZ. Eriobotrya japonica hydrophilic extract modulates cytokines in normal tissues, in the tumor of meth-A-fibrosarcoma bearing mice, and enhances their survival time. BMC Complement Altern Med. 2011; 11(9).
36. Cha DS, Eun JS, Jeon H. Anti-inflammatory and antinociceptive properties of the leaves of Eriobotrya japonica. J. Ethnopharmacol. 2011; 134: 305–312.
37. Kim MS, You MK, Rhuy DY, Kim YJ, Baek HY, Kim HA. Loquat (Eriobotrya japonica) extracts suppress the adhesion, migration and invasion of human breast cancer cell line. Nutr. Res. Pract. 2009; 3: 259–264.
38. Shafi S, Tabassum N. Effect Of Ethanolic Extract Of Fruits Of Eriobotrya Japonica On Lipid Profile And Body Weight In Streptozotocin Induced Diabetic Rats. International Journal of Pharmaceutical Sciences and Drug Research, 2019; 11(1): 01- 06.
39. Tamaya K, Matsui T, Toshima A, Noguchi M, Ju Q, Miyata Y, Tanaka T, Tanaka K. Suppression of blood glucose level by a new fermented tea obtained by tea-rolling processing of loquat (Eriobotrya japonica) and green tea leaves in disaccharide-loaded Sprague–Dawley rats. J. Sci. Food Agric. 2010; 90:779–783.
40. Kim JY, Hong JH, Jung HK, Jeong YS, Cho KH. Grape skin and loquat leaf extracts and acai puree have potent anti-atherosclerotic and antidiabetic activity in vitro and in vivo in hypercholesterolemic zebrafish. Int. J. Mol. Med. 2012; 30:606–614.
41. Shih CC, Lin CH, Wu JB. Eriobotrya japonica improves hyperlipidemia and reverses insulin resistance in high-fat-fed mice. Phytother. Res. 2010; 24:1769–1780.
42. Shih CC, Ciou JL, Lin CH, Wu JB, Ho HY. Cell suspension culture of Eriobotrya japonica regulates the diabetic and hyperlipidemic signs of high-fat-fed mice. Molecules, 2013; 18:2726–2753.
43. Toshima A, Matsui T, Noguchi M, Qiu J,Tamaya K, Miyata Y, Tanaka T, and Tanaka K. Identification of alpha-glucosidase inhibitors from a new fermented tea obtained by tearolling processing of loquat (Eriobotrya japonica) and green tea leaves. J. Sci. Food Agric. 2010; 90:1545–1550.
44. Oboh G, Agunloye OM, Adefegha SA, Akinyemi AJ, and Ademiluyi AO. Caffeic and chlorogenic acids inhibit key enzymes linked to type 2 diabetes (in vitro): a comparative study. J Basic Clin PhysiolPharmacol. 2015; 26:165– 170.
45. Alberti KG, Zimmet PZ. Definition diagnosis and classification of diabetes mellitus and its complications. Part I: diagnosis and classification of diabetes mellitus, provisional report of a WHO consultation. Diabetes Med. 1998; 15:539-53.
46. Shafi S and Tabassum N. Phytochemical Screening And Renal Effects Of Ethanolic Extract Of Eriobotrya Japonica Fruits And Seeds In Alloxan Induced Diabetic Rats. International Journal of Current Pharmaceutical Research, 2018; 10(1): 3-7.
47. Tanaka K, Tamaru S, Nishizono S, Miyata Y, Tamaya K, Matsui T, Tanaka T, Echizen Y, Ikeda I. Hypotriacylglycerolemic and antiobesity properties of a new fermented tea product obtained by tea-

rolling processing of third-crop green tea (Camellia sinensis) leaves and loquat (Eriobotrya japonica) leaves. Biosci. Biotechnol. Biochem. 2010; 74:1606– 1612.
48. Maher K, Yassine BA, Sofiane B. Antiinflammatory and antioxidant properties of Eriobotrya japonica leaves extracts. African Health Sciences, 2015; 15(2): 613-620.
49. Zar PPK, Sakao K, Hashimoto F, Morishita A, Fujii M, Wada K and Hou D. Antioxidant and anti-inflammatory activities of loquat (Eriobotrya japonica) tea. Functional Foods in Health and Disease, 2013; 3(11):447-461.
50. Seong N, Oh W, Kim I, Kim S, Seo J, Park C, Kim D, Ko J and Kim J. Efficacy and local irritation evaluation of Eriobotrya japonica leaf ethanol extract. Laboratory Animal Research, 2019; 35:4.
51. Banno N, Akihisa T, Tokuda H, Yasukawa K, Taguchi Y, Akazawa H, Ukiya M, Kimura Y, Suzuki T, Nishino H. Anti-inflammatory and antitumor-promoting effects of the triterpene acids from the leaves of Eriobotrya japonica . Biol Pharm Bull, 2005; 28 (10): 1995-1999.
52. Ge JF, Wang TY, Zhao B, Lv XW, Jin Y, Peng L, Yu SC and Li J. Anti-inflammatory effect of triterpenoic acids of Eriobotrya japonica (Thunb.) Lindl. leaf on rat model of chronic bronchitis. Am J Chin Med. 2009; 37: 309-321.
53. Zar PPK, Morishita A, Hashimoto F, Sakao K, Fujii M, Wada K, Hou DX. Anti-inflammatory effects and molecular mechanisms of loquat (Eriobotrya japonica) tea. J. Funct. Foods. 2014; 6:523–533.
54. Chang CT, Huang SS, Lin SS, Amagaya S, Ho HY, Hou WC, Shie PH, Wu JB, Huang GJ. Anti-inflammatory activities of tormentic acid from suspension cells of Eriobotrya Japonica ex vivo and in vivo. Food Chem. 2011; 127:1131–1137.
55. Sun G, Liu Y, Zhu J, Iguchi M, Yoshioka S, Miyamura M, Kyotani S. Immunomodulatory effect of Eriobotrya japonica seed extract on allergic dermatitis rats. J. Nutr. Sci. Vitaminol. 2010; 56:145–149.
56. Wu Y, Jian T, Lv H, Ding X , Zuo Y, Ren B, Chen J, Li W. Antitussive and expectorant properties of growing and fallen leaves of loquat (Eriobotrya japonica). Rev. bras. farmacogn. 2018; 28(2):239-242.
57. Hamalainen M, Nieminen R, Vuorela P, Heinonen M, Moilanen E. Anti-inflammatory effects of flavonoids: genistein, kaempferol, quercetin, and daidzein inhibit STAT-1 and NF-kappaB activations, whereas flavone, isorhamnetin, naringenin, and pelargonidin inhibit only NF-kappaB activation along with their inhibitory effect on iNOS expression and NO production in activated macrophages. Mediators Inflamm. 2007, 1-10.
58. Brightling CE, Ward R, Wardlaw AJ, Pavord ID. Airway inflammation, airway responsiveness and cough before and after inhaled budesonide in patients with eosinophilic bronchitis. Eur. Respir. J. 2000; 15: 682-686.
59. Huang Y, Li J, Meng XM, Jiang GL, Li H, Cao Q, Yu SC, Lv XW, Cheng WM. Effect of triterpene acids of Eriobotrya japonica (Thunb.) Lindl. leaf and MAPK signal transduction pathway on inducible nitric oxide synthase expression in alveolar macrophage of chronic bronchitis rats. Am. J. Chin. Med. 2009; 37: 1099-1111.
60. Agar N and Young AR. Melanogenesis: a photoprotective response to DNA damage? Mutat Res. 2005; 571:121–32.
61. Callender VD, St Surin-Lord S, Davis EC, Maclin M. Postinflammatory hyperpigmentation: etiologic and therapeutic considerations. Am J Clin Dermatol. 2011; 12:87–99.
62. Panich U, Tangsupa-a-nan V, Onkoksoong T, Kongtaphan K, Kasetsinsombat K, Akarasereenont P. Inhibition of UVA-mediated melanogenesis by ascorbic acid through modulation of antioxidant defense and nitric oxide system. Arch Pharm Res. 2011; 34:811– 20.
63. Tan H, Sonam T, Shimizu K. The potential of triterpenoids from loquat leaves (Eribotrya japonica) for prevention and treatment of skin disorder. Int J Mol Sci. 2017; 18(5):1030.
64. Park JO, Park JO, Joo CG. A study on whitening and anti-inflammatory effects of Eriobotrya japonica leaf extracts with different extraction methods. J Soc Cosmet Sci Korea. 2015; 41(2):151–7.

65. Christian L, Freia FS, Angela R, Szymon K, Daniel K, Bart DW, Heike W, Florian KG. Alternative methods for the replacement of eye irritation testing. ALTEX. 2016; 33(1):55–67.
66. Shahat AA, Ullah R, Alqahtani AS, Alsaid MS, Husseiny HA, and Al Meanazel OTR. Hepatoprotective Effect of Eriobotrya japonica Leaf Extract and Its Various Fractions against Carbon Tetra Chloride Induced Hepatotoxicity in Rats. Evidence-Based Complementary and Alternative Medicine, 2018; 9:1-8.
67. Zeashan H, Amresh G, Singh S, and Rao CV. Hepatoprotective activity of Amaranthus spinosus in experimental animals. Food and Chemical Toxicology, 2008;46 (11):3417– 3421.
68. Souza MF, Rao VSN, and Silveira ER. Inhibition of lipid peroxidation by ternatin, a tetramethoxyflavone from Egletesviscosa L. Phytomedicine, 1997; 4 (1):27–31.
69. Kumar SS, Kumar BR, and Mohan GK. Hepatoprotective effect of Trichosanthescucumerina var cucumerina L. on carbon tetrachloride induced liver damage in rats. Journal of Ethnopharmacology, 2009;123 (2): 347–350.
70. Esmaeili AH, Khavari-Nejad RA, Moghaddam AH, Chaichi MJ, and Ebrahimzadeh MA. Effects of Eriobotrya japonica (Lindl.) flower extracts on mercuric chloride-induced hepatotoxicity in rats. Chinese Science Bulletin, 2012; 57(30):3891–3897.
71. Yoshioka S, Hamada A, Jobu K, Yokota J, Onogawa M, Kyotani S, Miyamura M, Saibara T, Onishi S, Nishioka Y. Effects of Eriobotrya japonica seed extract on oxidative stress in rats with non-alcoholic steatohepatitis. J. Pharm. Pharmacol. 2010; 62:241–246.
72. Bae D, You Y, Yoon HG, Kim K, Lee YH, Kim Y, Baek H, Kim S, Lee J, Jun W. Protective effects of loquat (Eriobotrya japonica) leaves against ethanol-induced toxicity in HepG2 cells transfected with CYP2E1. Food Sci. Biotechnol. 2010; 19: 1093–1096.
73. Tapas AR, Sakarkar DM, Kakde RB. Flavonoids as Nutraceuticals: A review. Trop J Pharm Res. 2008;7(3):1089–99.
74. Reddy MK, Gupta SK, Jacob MR, Khan SI, Ferreira D. Antioxidant, antimalarial and antimicrobial activities of tannin-rich fractions, ellagitannins and phenolic acids from Punica granatum L. Planta Med. 2007;73(5):461–7.
75. Skalicka-Wozniak K, Melliou E, Gortzi O, Glowniak K, Chinou IB. Chemical constituents of Lavatera trimestris L.--antioxidant and antimicrobial activities. Z Naturforsch C. 2007; 62(11-12):797–800.
76. Tan H, Furuta S, Nagata T, Ohnuki K, Akasaka T, Shirouchi B, Sato M., Kondo R, Shimizu K. Inhibitory effects of the leaves of loquat (Eriobotrya japonica) on bone mineral density loss in ovariectomized mice and osteoclast differentiation. J. Agric. Food Chem. 2014; 62:836–841.
77. Tan H, Zhao C, Zhu Q, Katakura Y, Tanaka H, Ohnuki K and Shimizu K. Ursolic Acid Isolated from the Leaves of Loquat (Eriobotrya japonica) Inhibited Osteoclast Differentiation through Targeting Exportin 5. J. Agric. Food Chem. 2019; 67(12): 3333-3340.
78. Yang Y, Huang Y, Huang C, Lv XW, Liu L, Wang YY, Li J. Antifibrosis effects of triterpene acids of Eriobotrya japonica (Thunb.) Lindl. leaf in a rat model of bleomycin-induced pulmonary fibrosis. J. Pharm. Pharmacol. 2012;64: 1751–1760.
79. Kaur R, kaur U and Walia H. Evaluation of Free Radical Scavenging Activities of Aqueous Extracts of Fruits of Ziziphusmauritiana and Eriobotrya japonica Through in vitro antioxidant assays. Global Journal of Research and Review, 2015; 2(1): 30- 36.
80. Shekhar T C and Anju G. Antioxidant activity by DPPH radical scavenging method of Ageratum conyzoides Linn. leaves. American Journal of Ethno medicine, 2014; 1: 244-249.
81. Tosun M, Ercisli S, Karlidag H, Sengul M. Characterization of Red Raspberry (Rubus idaeus L.) Genotypes for Their Physicochemical Properties. Journal of Food Science, 2009; 74(7): 575–579.
82. Özgen U, Mavi A, Terzi Z, Kazaz C, Aşçı A, Kaya Y. and Seçen H. Relationship Between Chemical Structure and Antioxidant Activity of Luteolin and Its Glycosides Isolated from Thymus sipyleus subsp. sipyleus var. sipyleus. Rec Nat Prod. 2011; 5(1):12–21.