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Lokāt (*Eriobotrya japonica; family: Rosaceae*): Nutritional and Medicinal Properties, in the Light of Unani Medicine and Scientific Studies

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Authors' contributions

This work was carried out in collaboration among all authors. Author MAK designed the study, wrote the first draft of the manuscript. Authors BA, RA, CB, MA, FA and MAR manage the literature search. All authors read and approved the final manuscript.

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Review Article

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ABSTRACT

Eriobotrya japonica Lind. (Family: Rosaceae) named as *loquat*, is a subtropical fruit, which is well known medicinal plant cultivated in Japan and China. Various parts, like leaves, peels and fruits have been shown to possess various useful health benefits. In Unani medicine, it is vastly utilized in many illnesses, like fevers, nausea, de-arranged sanguinous humour (diseases due to morbidity of blood), indigestion, liver diseases, vomiting, dysentery, wounds, inflammations etc. Loquat plant contains many active constituents, such as glycosides, flavonoids, polyphenolic compounds, tannin etc. and nutritional and mineral compounds like, carotenoids, vitamins, starch, amino acids, sugar and others. According to various pharmacological studies it is found that the plant has many biological effects like antitussive, anti-melanogenic, anti-diabetic, anti-inflammatory, antimicrobial, kidney protective, 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.

Keywords: Eriobotrya japonica lind; loquat; lokāt; flavonoids; unani medicine; hepatoprotective.

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 planted for more than two thousand years, and is native to Japan and China but has recently cultivated commercially worldwide in over 30 countries, such as Japan, Turkey, Iraq, 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]. "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 has sweet taste" [1,2]. "Among other fruits, unusually loquat flowers in early winter or autumn, and the fruits ripe~~ns~~ in early spring or late winter" [4]. "Mainly its fruits are eaten but also have been utilized in jam, chutney, and jelly preparation" [5]. Loquat is planted mostly for fruit production, and in the Unani medicine "Loquat" is commonly known as "*Lokāt*" and has also been utilized for various medicinal purposes like treatment of nausea, vomiting, indigestion, dysentery, liver diseases, wounds, inflammations etc. Pharmacological studies have demonstrated that loquat exhibits various bioactive properties, including anti-inflammatory, diuretic, anti-tumor [6], hepatoprotective [7], and anti-HIV effects [8]. This review is compiled to gather the scattered information related to the phytochemicals, medicinal uses and scientific researches on Lokāt fruits and other parts of the tree.

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 Google Scholar, Research Gate; Scopus and PubMed indexed journals 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 and scientific researches.

3. OBSERVATIONS

3.1 Distribution

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

3.2 Botanical Description

"E. japonica Lindl. is a large, evergreen 5–10 meters (16–33 feet) tall but is often smaller, shrub or small tree with a rounded crown, a short trunk, and woolly new twigs. Flowers appear in the autumn or early winter, and the fruits are ripe at any time from early spring to early summer. The flowers are 2 cm (3/4 in) in diameter, white, with five petals, and produced in stiff panicles of three to ten flowers. They have a sweet, aroma.

The color of loquat fruit shows a marked change from green to yellow during its developmental and maturation period and become yellow to deep orange when ripen. The fruits begin to ripe from spring to summer, depending on the temperature in the area. The leaves are dark green, simple, alternate, 10–25 cm long, tough, and leathery in texture, with a serrated margin [11].

3.3 Taxonomic Classification

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

3.4 Description in Unani Literature

Lokāt is a tree introduced in India by English people. It reaches 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 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]. Mainly its fruits and juice (*Āb-i-Lokat*) are recommended by the Unani physicians.

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'āl wa Khawās* (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].

3.8 Traditional uses and Dosage Forms of Lokāt

Various parts of the plant are used to treat respiratory and digestive disorders and also to cure inflammations, wound and *Diabetes mellitus* etc. The uses are mentioned bellow:

3.8.1 *Amrāḍ-i-Ri'a* (*Respiratory diseases*)

- 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].

3.8.2 *Amrad-i-Nizām-i-Haḍm* (*Digestive 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]

3.8.3 *Inflammation and wounds*

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

3.8.4 *Dhayābītus* (*Diabetes mellitus*)

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

3.9 *Maḍarrat* (toxicity, side effect or adverse effect, contraindication)

The fruit is contraindicated for the person having cold and phlegmatic temperament [13].

3.10 *Musleh* (Corrective)

To counter its side effects due to over use, *Mirch Siyāh* (black piper) and *Namak* (salt) can be used as correctives [13].

3.11 *Badal* (Substitute or Alternative)

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

3.12 *Miqdār Khūrāk* (Dosage)

2-4 pieces are taken therapeutically [13].

3.13 Compound Formulations

In Unani medicine Ab-i-Lokāt and Sharbat-i-Lokāt are used for above mentioned medical conditions.

3.14 Phytoconstituents

In loquat, a broad range of phytochemical compounds like phenols, alkaloids, cardiac glycosides, flavonoids, mucilage, gums, and phytosterols have been reported, [16] that are responsible for various biological activities [17]. "By using high performance liquid chromatography, flavones like quercetin derivatives, 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" [18]. The presence of bioactive and nutritional compounds in various parts of the plant is mentioned in Table 1.

3.15 Pharmacological Activities of *Eriobotrya japonica*

3.15.1 Cytotoxic activity

"According to a study of loquat juice on cancer cell lines revealed that it contains polyphenolic compounds that stimulate glutathione-S-transferase enzymes (GSTs) [31]. These GSTs act as antioxidants, promoting cellular detoxification and apoptosis in cancer cells" [32]. Alwash (2017) reported that, "loquat fruit juice exhibited a pronounced anticancer effect on rhabdomyosarcoma (RD) and human cervical cancer (HeLa) cells" [2].

3.15.2 Anti-diabetic activity

Shafi et al. reported (2019) that in "streptozotocin induced diabetic rat, the ethanol loquat fruit extract showed good anti-diabetic effect" [33]. "Also, study done on maltose-loaded Sprague–Dawley rats, combination of green tea leaves and loquat leaves exhibited a reduction of blood levels of glucose and a corresponding decrease in serum secretion of insulin" [34].

3.15.3 Kidney protective effect

"Diabetes mellitus is a metabolic disease differentiated by hyperglycemia and several complications, such as neuropathy, retinopathy, angiopathy, nephropathy etc" [35]. Shafi et al. (2018) reported that, "ethanolic extract (50%) of seeds and fruits of *Eriobotrya japonica* displayed renal effects in alloxan induced diabetic rats, which was evaluated by estimating serum total proteins, serum creatinine and urea levels. The results showed a nonsignificant elevation in level of total proteins and reduction in levels of serum urea, creatinine and also had effects on levels of serum glucose" [36].

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

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

S.No.	Parts of the plant	Bioactive compounds	Nutritional compounds
1	Fruit	In fruits presence of flavonoids, phenols, [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 reported [20].	The fruit contains sugars: levulose and sucrose; citric acid, tartaric acid, succinic acid, cryptoxanthin, β-carotene, neo-β carotene. The seeds contain amygdalin and fatty oil, [30], starch [19], Carbohydrates, protein, amino acids [16], Vitamins, carotenoid [19]. The kernel of loquat is rich with starch, minerals and proteins [21,22].
2	Kernel	The kernel of loquat is rich with tannins, [21,22], amygdalin, a cyanogenetic glycoside [23].	
3	Flowers	Flavonoids and phenolic compounds [24], oleanolic and ursolic acids are reported in loquat flowers [20]. 15 aromatic compounds are present in the flowers, and the most potent aromatic compound in fresh loquat is phenylacetaldehyde. Additionally, other aroma such as, hexanal, (E)-2-hexenal, hexanoic acid, and β-ionone are important also have been reported also. [25] Presence of amygdalin is also reported [26]. Flowers possess a higher content of quercetin and chlorogenic acid derivatives than new and old leaves [18].	
4	Leaves	In the leaves of loquat, phenolic acids like p-coumaric, gallic, caffeic, ellagic acid, tormentic acid, and flavonoids like quercetin, epicatechin, and catechin have been identified [27,28] in addition to tannins, sesquiterpenes, triterpenes and megastigmane glycosides [24,29]. The isomeric pentacyclic oleanolic acid and ursolic acid are predominant triterpenoids found in *E. japonica* leaves [30]. Amygdalin, a cyanogenetic glycoside is also present in in considerable amounts [23]. The new leaves possess phenolic and caffeic acid derivatives [18]	
5	Stem	In stem four flavonoids, kaempferol 3-O-β-glucoside, quercetin, quercetin 3-O-α-rhamnoside, naringenin, and three triterpene acids, ursolic, corosolic, and	

S.No.	Parts of the plant	Bioactive compounds	Nutritional compounds
		oleanolic acids, were reported [24].	
6	Stem bark	Stem bark contains catechin, β-sitosterol, β-sitosterol-3-O-β-D-glucopyranoside, oleanolic acid, cinchonain IIb, lyoniresinol, and lyoniresinol 2-a-O-β-Dxylopyranoside [1].	

3.15.4 Hypolipidemic activity

Shafi et al. (2019) reported that "in streptozotocin induced diabetic rat, the ethanolic extract of fruit *Eriobotrya japonica* showed significant hypolipidemic activity" [36]. "In high-fat diet mice, ethanolic extracts of loquat exhibited hypolipidemic activity as it decreased white adipose tissue (WAT) weight (include visceral fat, mesenteric, peri-renal, and epididymal WAT), body weight gain, hepatic tri-acylglycerol, and adipocyte size in the visceral depots" [37,38]. "Fermented tea product (leaves mixture of both green tea and loquat) inhibited the synthesis of hepatic fatty acids and postprandial hypertriacylglycerolemia by inhibition of pancreatic lipase, exhibiting anti-obesity action" [39]. "The aqueous extract of loquat leaves exhibited an anti-atherosclerotic effect in a hypercholesterolemic zebra fish model and in cellular assays" [40].

3.15.5 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 phospholipase A2 group IB (pG-IB) secreted in pig and the human secreted phospholipase A2 group IIA (hG-IIA)" [41]. "The N-butanol fraction of leaves of loquat demonstrated anti-inflammatory property by inhibiting the expression of nitric oxide synthase and production of NO, also down-regulated cyclooxygenase-2 expression, pro-inflammatory cytokine secretion such as interleukin-6 and tumor necrosis factor-α (TNF-α) in the LPS-activated murine peritoneal macrophage model" [42]. Seong et al (2019) reported that "in lipopolysaccharide-induced RAW 264.7 macrophage cells, the ethanolic extract of loquat leaves showed an anti-inflammatory effect by suppressing TNF-α production and NO expression" [43]. Zar et al. (2013) reported that "in lipopolysaccharide-induced RAW 264.7 cells, aqueous extract of loquat leaves extracted by boiling for 15 minutes at 100°C, exerted an anti-inflammatory effect via inhibiting PGE2 and COX-2 production. The new bioactive phenolic compounds in loquat tea may be responsible for its anti-inflammatory potency" [44]. "Loquat tea water extract prepared by boiling it 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" [45]. "This was observed in macrophage-like RAW 264.7 cells used in the mouse paw edema model" [45,46].

3.15.6 Antitussive and expectorant activity

Wu et al. (2018) reported that "the ethanolic and aqueous extracts of loquat leaves showed expectorant and antitussive effects. Aqueous extracts of growing leaves had a higher expectorant effect, which may be related to their higher flavonoid content, such as quercetin, isoquercitrin, hyperoside, rutin, and others. Meanwhile, ethanolic extracts of fallen leaves demonstrated better antitussive effects, which may be related to their higher triterpenoids content, such as tormentic acid, corosolic acid, maslinic acid, ursolic acid, and others" [46].

3.15.7 Anti-melanogenic activity

Seong et al. (2019) stated that ethanolic leaf extract of loquat showedanti-melanogenic activity because of its anti-inflammatory and anti-oxidant activities. The ethanolic extract has a higher concentration of quercetin and other polyphenols that limit the creation of melanin, it shows protection of human skin from oxidative stress and inflammation. Since melanin is crucial in preventing the generation of UV-stimulated ROS, ethanolic extract can control melanin formation. It also exhibits strong anti-inflammatory and antioxidant properties [43,47]. In B16 melanoma cells, the methanolic leaf extract of *Eriobotrya japonica* exerted dose-dependant melanogenesis suppression [43,47,48]. Furthermore, 70% and 30% loquat leaf ethanolic extracts inhibited mushroom tyrosinase for having whitening effects [49].

3.15.8 Hepatoprotective activity

The study conducted by Shahat et al. (2018) shown that the methanolic extract (80%) of loquat leaves, as well as its butanol, aqueous, and ethyl acetate fractions, had hepatoprotective effects in rats with hepatotoxicity induced by CCl4.

It 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. Administration of butanol and ethyl acetate fractions significantly suppressed CCl4-stimulated depletion of total protein and the reduced levels of nonprotein sulfhydryl groups (NP-SH) [50].

3.15.9 Antimicrobial activity

Rashed et al. (2014) reported that the methanolic extract (80%) of stems of loquat extracted by maceration process,demonstrated an antimicrobial effect against bacterial and fungal strains linked to the presence of triterpenes and flavonoids. It was found to be more effective against Candida albicans, indicating that it can be used to treat fungal infections and has no effect on other strains of bacteria or fungus [24].

The presence of flavonoids [51], tannins [52], and kaempferol 3-O-β-glucoside [53] in the methanolic extract of loquat stems are responsible for its strong antibacterial and antioxidant properties.

3.15.10 Antiosteoporosis activity

Methanolic leaf extract of loquat showed antiosteoporotic effects in the model of ovariectomized mice [54]. Ursolic acid was isolated from loquat leaves and displayed an inhibitory effect on osteoclast differentiation. Ursolic acid was found to suppress the development of osteoclasts by targeting exportin 5 (XPO5), a nuclear exporter protein, to decrease osteoclast development [55].

3.15.11 Antifibrosis activity

In a rat model of bleomycin-induced pulmonary fibrosis, triterpenic acids from an ethanolic extract of loquat leaves (prepared by cold technique, 2 hours) showed antifibrotic efficacy by reducing lung fibrosis and enhancing lung architecture. Rats with pulmonary fibrosis had lower levels of TGF-β1 and TNF-α production in their macrophages, both in terms of mRNA and protein [56].

3.15.12 Antioxidant activity

Alwash (2017) reported that the fruit juice of E. japonica has shown antioxidant properties [2]. By contributing their H atoms, the plant's juice can scavenge DPPH free radicals [57]. The phenolic compounds found in E. japonica fruit juice, particularly flavonoids, have the capacity to cause this reaction [17]. Their efficacy as antioxidants depends on the location and quantity of OH groups on the basic flavonoid structure; an increase in the number of hydroxyl groups is directly associated with an increase in antioxidant activity [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 Lokāt’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.

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CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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. Lin S, Sharpe RH, Janick J, In: Jules, J. (Ed.), Loquat: Botany and Horticulture, Horticultural Reviews, 23. Wiley, New York. 1999:234–276.
10. Kalam, MA. Fawakeh Kashmir. New Delhi; Idara Kitabus Shifa; 2021.
11. Kirtikar and Basu. Indian Medicinal Plants.Periodical Expert Book Agency, New Delhi. Vol II, 2012;989-990.
12. Ghani HN. Khazainul Advia. New Delhi; Idāra Kitabus Shifa; 2011.
13. Hakim, MA. Bustanul Mufradat. New Delhi; Idāra Kitabus Shifa; 2011.
14. Kabiruddin HM. Makhzan al-Mufradat. New Delhi: Idara Kitab al-Shifa. 2014;365-66.
15. Khan A. Haziq. New Delhi: Idāra Kitab us Shifa. 2017;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, 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. 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.
34. 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.
35. 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.
36. 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.
37. 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.
38. 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.
39. 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.
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. Maher K, Yassine BA, Sofiane B. Antiinflammatory and antioxidant properties of Eriobotrya japonica leaves extracts. African Health Sciences, 2015; 15(2):613-620.
42. Cha DS, Eun JS, Jeon H. Anti-inflammatory and antinociceptive properties of the leaves of Eriobotrya japonica. J. Ethnopharmacol. 2011;134: 305–312.
43. 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.
44. 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.
45. 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.
46. 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.
47. Agar N and Young AR. Melanogenesis: a photoprotective response to DNA damage? Mutat Res. 2005;571:121–32.
48. 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.
49. 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.
50. 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.
51. Tapas AR, Sakarkar DM, Kakde RB. Flavonoids as Nutraceuticals: A review. Trop J Pharm Res. 2008;7(3):1089–99.
52. 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.
53. 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.
54. 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.
55. 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.
56. 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.

57. 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.

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