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REVIEW ARTICLE

A Critical Review on Loquat (*Eriobotrya japonica* Thunb/ Lindl)

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ABSTRACT

Eriobotrya japonica is an evergreen tree belonging to the family Rosaceae, which is commonly known as loquat. It is grown commercially for its yellow fruits and also cultivated as an ornamental plant in Japan and other Asian countries. Its leaves are listed in the Japanese Pharmacopeia and are used widely as traditional herbal medicine for the treatment of chronic bronchitis and coughs. Loquat fruits have been used since time immemorial in the ethno medicine for numerous diseases including asthma, gastro-enteric disorders, diabetes mellitus common cold and chronic liver disorders. Loquat fruit and leaves have high concentrations of vitamin-A, ascorbic acid, calcium, iron, manganese, potassium, and pharmacologically active constituents are kaempferol, ursolic-acid, oleanolic-acid, tartaric acid, quercetin, amygdalin, etc. It also possesses several pharmacological properties, including anti-inflammatory, anti-tumor, antioxidative, antimutagenic and anti-diabetic activity etc.

Key words: Loquat, pharmacological properties.

INTRODUCTION

Eriobotrya japonica (loquat) is a species of flowering plant of the family Rosaceae, native to south-central China. It is a large evergreen shrub or small tree, grown commercially for its yellow fruit, and also cultivated as an ornamental plant. It is also known as **Japanese plum** and **Chinese plum**. The generic name is derived from the Greek words 'erion' (wool) and 'botrys' (cluster), from the woolly appearance of the spiked inflorescence; the specific epithet means 'of Japan' [1]. It is commonly called as Loquat. It is adapted to a subtropical to mild-temperate climate. In China it grows naturally at altitudes between 3,000 and 7,000 ft (914-2,100 m). In India, it grows at all levels up to 5, 000 ft (1,500 m). Loquat fruits are often used as food and their skin can be peeled and eaten. They are often combined with other fruits. Loquat fruit and leaves have high concentrations of Calcium, Phosphorus, Iron, Potassium, Vitamin A and Ascorbic Acid [2]. Organic Loquat Leaf is often used to make medicinal teas. The fruit is sometimes used as a sedative and is thought to reduce vomiting and thirst when ingested. Leaves can relieve diarrhea, depression and counteract intoxication. Leaves can also reduce swelling. During ripening, many metabolic changes in the fruit lead to the development of color, texture, and flavor making the fruit acceptable to consumers and subsequently establishing the nutritional and sensorial quality, as well as the shelf-life of the fruit.

TAXONOMICAL CLASSIFICATION [3]:

Kingdom	=	Plantae
Subkingdom	=	Viridaeplantae
Division	=	Tracheophyta
Subdivision	=	Spermatophytina
Class	=	Magnoliopsida
Order	=	Rosales
Family	=	Rosaceae
Genus	=	Eriobotrya
Species	=	Eriobotrya japonica (Thunb.)

SYNONYMS:

Crataegus bibas Lour., *Mespilus japonica* Thunb., *Photinia japonica* (Thunb.) [4]

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VERNACULAR NAMES: [5,6]

Language	Name	Language	Name
Japan	*biwa*.	English	Green loquat, Japanese loquat, Japanese medlar, Japan-plum, loquat, stinking toe
China	*Lo Guat*	Hindi	Lokat
Italian	*nespola giapponese*	Indonesian	lokwat, papalaan
French	*néflier du Japon*, or *bibassier*	Khmer	tôn leap
German	*japanische mispel, wollmispel*	Thai	Pipae
Spanish	*nispero, nispero japonés*	Kannada	Lakkote
Portuguese	ameixa do Japao	Tamil	ilakotta, nokkotta
Malay	lokwat, paginggong		

BOTANICAL DESCRIPTION [7]:

Habit: A large evergreen shrub or small tree 6-8 m high; with a ovoid or globular crown, short trunk, bark being grey and shallowly fissured, on young branches it is pale brown and hairy (**Fig 2**).

Leaves: are somewhat crowded towards the end of the stout, woolly branchlets, large, alternate, subsessile, stiff, coriaceous, elliptic, lanceolate to obovate, lanceolate in outline, 21-32 cm in length, with remotely toothed to sharply dentate margins; dark, glossy, green above and rusty-tomentose below; base green, obtuse or narrowed into a very short, stout, woolly, stipulate petiole.

Flowers: fragrant, 1.2 cm broad, borne in woolly panicles, 10-20 cm long; calyx composed of 5 small, imbricate, acute teeth; corolla has 5 oblong, ovate-clawed petals, white in colour and delicate in texture; stamens 20; pistils 5, joined towards the base (**Fig 1**).

Fruits: borne in clusters, commonly round, oval or pyriform, 2.5-8 cm in length, pale yellow to orange, somewhat downy on the surface; skin about as thick as that of a peach, but slightly tougher; flesh firm and fleshy in some varieties, melting in others, the colour ranging from almost white to deep orange, juicy and with subacid flavour; Each fruit contains from one to ten ovules, with three to five being most common. The fruits are the sweetest when soft and orange. The flavor is a mix of peach, citrus and mild mango (**Fig 3**).

Seeds: 4-10, brownish, oblong, 1-2 cm long.

Flowering and Fruiting: The flowers appear in the autumn or early winter, and the fruits are ripe in late winter or early spring. Many E. japonica cultivars exist. Based on origin, 2 groups are distinguished: the Chinese groups with large, pyriform, deep orange fruit, which can be kept for 1-2 weeks, and the Japanese group with small, slender, light-coloured fruit, maturing early and having a shorter shelf life.

Fig 1: Flowers

Fig 2: Loquat Plant

Fig 3: Fruit

DISTRIBUTION [8]:

Loquat is indigenous to southeastern China and possibly southern Japan, though it may have been introduced into Japan in very early times. It is said to have been cultivated in Japan for over 1, 000 years. The western world first learned of it from the botanist Kaempfer in 1690. Thunberg, who saw it in Japan in 1712, provided a more elaborate description. It was planted in the National Gardens, Paris, in 1784 and plants were taken from Canton, China, to the Royal Botanical Gardens at Kew, England, in 1787.Cultivation spread to India and Southeast Asia, the medium altitudes of the East Indies, and Australia, New Zealand and South Africa. In India the tree has become naturalized, as it volunteers readily from seed. Now a days it is cultivated mainly in Saharanpur, Dehradun, Muzaffarnagar, Meerut, Kanpur, Bareilly districts of Uttar Pradesh, Amritsar, Gurdaspur and Hoshiarpur districts of Punjab [9].

PROPAGATION AND CULTIVATION:

Generally, seeds are used for propagation only when the tree is grown for ornamental purposes or

for use as rootstock. Loquat seedlings are preferred over apple, pear, quince or pyracantha rootstocks under most conditions. Quince and pyracantha may cause extreme dwarfing-to less than 8 ft (2.5 in). Quince rootstock tolerates heavier and wetter soils than loquat but is apt to put out numerous suckers. Loquat seeds remain viable for 6 months if stored in partly sealed glass jars under high humidity at room temperature, but the best temperature for storage is 40°F (5°C). They are washed and planted in flats or pots soon after removal from the fruit and the seedlings are transplanted when 6 to 7 in (15-17.5 cm) high to nursery rows. When the stem is 1/2 in (1.25 cm) thick at the base, the seedlings are ready to be top-worked. In India, inarching is commonly practiced but budding and grafting are more popular in most other areas. Shield-budding, using 3-month-old scions is successful. Cleft-grafting has been a common practice in Florida. Veneer-grafting in April has proved to be a superior method in Pakistan. Cuttings are not easy to root. Air-layering may be only 20% successful, though 80 to 100% of the layers root in 6 weeks if treated with 3% NAA (2-naphthoxyacetic acid) [10].

CHEMICAL CONSTITUENTS [11-13]:

Fruits: Fruit flesh contains malic acid, cryptoxanthin, tartaric acid, citric acid, tannate, carotene, vitamins A, B and C. Fruit kernel contain amygdalin (anti-cancer vitamin, B17 or laetrile).

Leaves: ursolic-acid, amygdalin, oleanolic-acid, rutin, maslinic-acid.

Flowers: Identified compounds in the essential oil of fresh flowers-

A) Hydrocarbons: (i) alkanesalkenes=Hexadecane,Heptadecane,Tricosane, Tetracosane, Pentacosane, Octacosane. (ii) aldehydes= Hexadecanal, Octadecanal. (iii) ketones= 6.10.14-trimethyl-2-pentadecanone.

B) Esters= 4-methoxy methylbenzoate, 4-methoxy ethylbenzoate, phenyl ethyl octanoate.

C) Terpenoids= oxygenated sesquiterpene-nerolidol.

D) Fatty acids and fatty acid esters= tetradecanoic acid, methyl hexadecanoate, hexadecanoic acid, methyl linoleate.

Biological Activities and Pharmacological Active Constituents found in different parts of *E.japonica* [14]

Activities	Plant	Leaf	Fruit
Anticancer:	Caffeic-acid Kaempferol	Benzaldehyde Rutin	
Antimutagenic:	Caffeic-acid Kaempferol Quercetin	Rutin Ursolic-acid	Cryptoxanthin
Antinitrosaminic:	Caffeic-acid		
Antioxidant:	Caffeic-acid Cyanidin Kaempferol Quercetin	Oleanolic-acid Rutin Ursolic-acid	
Antiperoxidant:	Caffeic-acid Quercetin		
Antitumor:	Caffeic-acid Quercetin	Benzaldehyde Rutin Oleanolic-acid Ursolic-acid	

NUTRITIONAL VALUE:

Fresh fruit: Nutritional Value per 100 g [15]

	Nutrient Value	Percentage of RDA
Energy	47 Kcal	2.4%
Carbohydrates	12.14 g	9%
Protein	0.43 g	2%
Total Fat	0.20 g	1%
Dietary Fiber	1.70 g	4%
Vitamin A	1528 IU	51%
Vitamin C	1 mg	2%
Riboflavin	0.024 mg	2%
Pyridoxine	0.100 mg	8%
Thiamin	0.019 mg	2%
Folates	14 µg	3.5%
Potassium	266 mg	6%
Calcium	16 mg	1.6%
Copper	0.040 mg	4.5%
Iron	0.28 mg	3.5%
Magnesium	13 mg	3%
Manganese	0.148 mg	6.5%
Phosphorus	27 mg	4%

MEDICINAL USES [16-19]:

Fruits: The flesh promotes the secretion of body fluids and eliminates thirst. Loquats are highly recommended in cases of excess uric acid, kidney stones, kidney failure, and gout. This is due to their effectiveness as a diuretic by increasing the production of urine and promoting the elimination of excess uric particles as well as its low protein and high mineral content. Loquat helps decongest the volume of an enlarged liver (hepatomegaly) and also reduces ascites that are followed by liver degeneration. The regular consumption of loquat proves somehow effective in cases of Chronic liver diseases as: Cirrhosis, Hepatitis, Fatty degeneration of the liver. Regular consumption of loquats in cases of common cold is highly beneficial.

Leaves: The tender leaves are used for various types of coughs but the underside is usually prepared by rubbing the hairs off so they do not irritate the throat. Leaves are used for the treatment of diabetes mellitus, skin diseases and are used as a folk medicine for the treatment of chronic bronchitis, coughs, phlegm, high fever and ulcers. A traditional therapy uses the leaves to treat Cancers in Japan. An infusion of the leaves, or the dried, powdered leaves, may be taken to relieve diarrhea and depression and to counteract

intoxication from consumption of alcoholic beverages. Loquat leaf's oldest reported benefit is the reduction of skin inflammation and when Loquat leaf is used in topical cream, it can combat edema and histamine-induced skin contraction. Leaf poultices are applied on swellings. Leaf should not be used for cough caused by cold.

Flowers: Flowers are Expectorant.

OTHER USES:

Food: The fruits are rich in provitamin A, having a very high carotene content. E. japonica is usually eaten fresh but may be stewed, served as a sauce, syrup or jam, or made into an excellent jelly. The fruits are a good source of acid and pectin. The seeds, which have an almond like taste, are used to flavor drinks and cakes. **Fodder:** Tender branches are used as fodder in India. **Apiculture:** Bees are easily attracted to the fragrant, white flowers. Honey is amber colored with an agreeable flavor. **Timber:** E. japonica has a medium-weight to heavy heartwood which is pale purple-brown with darker streaks, not clearly differentiated from the sapwood. The wood has very little tendency to split, much harder, and takes a good polish. It is suitable for poles and posts, carving and drawing materials such as rulers, and is in demand for making stringed musical instruments. **Alcohol:** The fruit juice of E. japonica can be used to prepare an alcoholic drink. **Poison:** The seeds are poisonous and should be removed before cooking the fruit. The flowers are used as an insect repellent.

PHARMACOLOGICAL ACTIVITIES:

It is said to possess various pharmacological activities such as antioxidant, anti-inflammatory, hypo-lipidemic, anti metastatic activity, anti diabetic, antibacterial, analgesic, antiemetic, antitussive, antiviral, astringent, diure tic, expectorant, sedative activities.

Antioxidant activity:

Eriobotrya japonica plant was valuated using the Trolox equivalent antioxidant capacity (TEAC) and ferric reducing antioxidant power (FRAP) assays, and their total phenolic content was measured by the Folin-Ciocalteu method. The strong correlation between TEAC value and FRAP value suggested that the antioxidants in this plant possess free radical scavenging activity and oxidant reducing power, and the high positive correlation between antioxidant capacities and total phenolic content. Fruits shows very high amount of antioxidant property and is a potential source of natural antioxidant [20].

Anti-inflammatory activities:

Leaves had potent inhibitory effects on the inflammatory mediators including nitric oxide, iNOS, COX-2, TNF-α and IL-6 via the attenuation of NF-κB translocation to the nucleus. Leaves also showed excellent antinociceptive activity in both central and peripheral mechanism as a weak opioid agonist. Based on these results, Leaves may possibly be used as an anti-inflammatory and an analgesic agent for the treatment of pains and inflammatory diseases [21].

Hypolipidemic activity:

Hypercholesterolemia is often associated with obesity, diabetes mellitus and hypertension, each and all contribute to elevated cardiovascular mortality. Loquat (Eriobotrya japonica) leaf extracts have successfully shown anti-oxidant and anti hypercholesterolemic properties. Hypolipidemic properties were assessed in a double blinded- randomized clinical study carried out among 41 human volunteers with hyperlipidemia values. The volunteers were divided into three groups. They were asked to continue their usual diet and medications unchanged and were evaluated for efficacy and tolerability of Cholevel for 3 months [22,23].

Anti-metastatic activity:

Anti-metastatic action of the EtOAc fraction of the leaves of *E.japonica* was investigated, leaves showed potent inhibitory effects on MMP-2 and MMP-9 activities and expressions via down-regulation of NF-kB translocation to the nucleus in B16F10 cells. In addition, the cell migration and invasion were down-regulated, leaves also significantly suppressed lung metastasis in vivo. Isolated compounds ursolic acid and 2α-hydroxyursolic acid from leaves significantly suppressed MMP-2 and MMP-9 activities. This study demonstrates that leaves of E.japonica may be used as valuable anti-metastatic agent for the treatment of cancer metastatic [24].

Anti-diabetic activity [25-28]**:**

The sesquiterpene glycoside isolated from the leaves of Loquat plant which acts as hypoglycemic agent. Extracts from these leaves have been reported to exhibit a significant hypoglycemic effect. Leaf extracts of the loquat plant inhibit 11β-HSD1 over 11β-HSD2 this will contribute to the antidiabetic effect of the loquat plant. The 11β-HSD1 is the Glucocorticoid activating enzyme 11β-hydroxysteroid

dehydrogenase. The leaf extract of the plant is also used as oral hypoglycemic agent which is used in diabetes and diabetic cardiovascular complications have been used in clinical practice in South East Asia especially China, Japan and Korea. The various parts of the plant have proved to be antidiabetic.

Antibacterial activity [29]**:**
Leaf and branch extracts of *Eriobotrya japonica* shows the highest antibacterial activity against ESBL producing *Escherichia coli* and *Klebsiella pneumoniae* was mainly manifested by ethyl acetate fractions of both leaf and branch extracts; the other fractions exhibited less antibacterial affect.

Liver function improvement:
Evaluation of the pharmacological efficacy of the seed extracts reveals that constituents of the seeds contain the unsaturated fatty acids linolenic and linoleic acids and the sterol b - sitosterol in the 70% EtOH and the MeOH extracts. the positive effect on liver function of the extracts varies depending on the extracting solvent used. 70% EtOH and MeOH extract of the seeds inhibited the development of liver fibrosis in hepatopathic rats, thus exhibiting potent improvement. The unsaturated linolenic and linoleic acids and the sterol b -sitosterol contained in these extracts may also contribute to the improvement of liver function [30].

Antimutagenic activity:
Ursolic acid is isolated from the ethanolic extract of the plant decreased the numbers of *Salmonella typhimurium* TA 100 revertants per plate thus showing antimutagenic activity [31].

Antiviral activity:
The phytochemicals found in the plant such as oleanolic acid, pomolic acid, and structurally related triterpenoids have also anti HIV activity and 3-O-acyl ursolic acid derivatives is effective against AIDS virus [32].

Anti-HIV activity: Loquat leaf can have a mild suppressive effect on the HIV virus. This use is possible because of the acids present in this herb. One of these acids in organic Loquat leaf is the 2-alpha-hydoxyursolic acid and it has the anti-HIV effect [33].

CONCLUSION

Delicious, loquats are very low in calories; provide just 47 calories per 100 g, however, rich in insoluble dietary fiber, pectin. Pectin retains moisture in the colon and thus functions as bulk laxative and by this way, it helps to protect the mucous membrane of the colon by decreasing exposure time to toxic substances as well as binding to cancer-causing chemicals in the colon. Loquat fruit is an excellent source of vitamin-A and phenolic flavonoid antioxidants. Vitamin A maintains integrity of mucus membranes, and skin,consumption of natural fruits rich in vitamin-A, and flavonoids helps to protect from lung and oral cavity cancers.

Fresh fruit is very rich in potassium and some B-complex vitamins such as folates, vitamin B-6 and niacin and contain small amounts of vitamin-C. Potassium is an important component of cell and body fluids, helps controlling heart rate and blood pressure.
Furthermore, the fruit is also a good source of iron, copper, calcium, manganese, and other minerals. Manganese is used by the body as a co-factor for the antioxidant enzyme, superoxide dismutase. Copper is required in the production of red blood cells. Iron is required as a cofactor in cellular oxidation as well for red blood cell formation. Loquat fruit is highly nutritious value which can play a great role in human health.

Loquat is very useful drug with wide range of medicinal utility in various health ailments and wide range of pharmacological activities. Eriobotrya japonica shows different kinds of pharmacological activities such as Antibacterial activity, Antioxidant activity, Hypolipidemic activity, antimutagenic activity, Antiviral activity, Anti-HIV activity, Anti-diabetic activity etc. which provides a wide range of scope for the researchers to explore and evaluate the therapeutic utility of the drug.

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