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**BOTANICAL DESCRIPTION AND PHARMACOLOGICAL ACTIVITIES OF
LOQUAT (*ERIOBOTRYA JAPONICA* LINDL): A REVIEW**

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ABSTRACT

Loquat (*Eriobotrya japonica* Lindl.) is a subtropical evergreen perennial fruit shrub or small tree that originated in southeastern China and Southeast Asian nations such as Vietnam, Laos, and Myanmar, which border Yunnan province. Loquat fruit is high in minerals, carbohydrates, carotenoids, and organic acids, and is regarded a good source of all necessary elements. Loquat fruits are high in phytochemicals such as carotenoids, phenolics, flavonoids, Vitamin C and terpenoids, all of which are beneficial to human health. Traditional Chinese medicine uses all parts of the loquat plant. Various extracts of loquat have been demonstrated to exhibit hepatoprotective, gastroprotective, anti-inflammatory, antioxidant, hypoglycemic or antihyperglycemic, hypolipidemic, antiallergic, antiviral, anticancer, and anti-platelet effects in pharmacological tests.

KEYWORDS

Phytocompounds, Antioxidant activity and *Eriobotrya japonica*.

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INTRODUCTION

Loquat is a subtropical evergreen fruit tree native to Southeast China. China, Spain, Japan, India, Pakistan, Turkey, Israel, Egypt, Cyprus, Italy, France, Australia, Mexico and Tunisia are just a few of the nations that grow loquat^{1,2}. China produces the most loquat fruit per year (one million tonnes), followed by Spain (40,000tonnes), Pakistan (30,000tonnes) and Turkey (10,000-20,000tonnes)³. Loquat is a little fruit crop that is prized for its appealing flavour, which is sweet and mild. It is a golden, round or oval fruit with three to five big seeds that make about 20-30% of the total weight of the fruit^{4,5}. It has a high economic value as well as a

variety of beneficial substances such as flavonoids and dietary carotenoids, while the fruit kernels are 71.2 percent carbohydrate and 22.5 percent protein. Fruit also has a high concentration of carbohydrates, vitamins, minerals, phenolic acids, and organic acids^{6,7}. It can be eaten raw or processed in the form of juice, jam, syrup, wine, and fruit sweets. When compared to the consumption of fresh fruit, the economic advantage is up to thrice after processing^{8,9}. The loquat fruit has a wide range of therapeutic properties, including hypoglycemic, antioxidant, antiviral, anticancer, antiinflammatory, cytotoxic, antimutagenic, and hypolipidemic effects¹⁰. Loquat extracts have also been shown to be useful in the treatment of cancer, chronic bronchitis, cough, and diabetes³. Despite disagreement among experts over the number of loquat species, 17 species and three botanical variations have been identified. Only *E. japonica* is grown for fruit production, whereas *E. prinoides*, *E. deflexa*, and other species are used as rootstocks¹¹. Loquat is split into red-fleshed and white-fleshed variants based on the colour of the fruit flesh. Carotenoids are greater in red-flesh loquats, but glutamic acid is higher in white-flesh loquats¹².

Local Names

Amharic (woshmella); Cantonese (lukuh, lukwat, pi-pa); Chinese (luju, biba); Creole (lokwat); English (loquat, Japan-plum, Japanese medlar, Japanese loquat, green loquat, stinking toe); French (bibassier du Japon, bibace, neflier du Japon); German (Loquate, japanische mispel, Japanische Wollmispel); Hindi (lokat); Indonesian (papalaan, lokwat); Italian (nespola Giappone, nispolero).

BOTANIC DESCRIPTION

Eriobotrya japonica is a 6-8m tall evergreen shrub or small tree with a 0.6-1m long bole and a thick, ovoid or globular crown; the bark is grey and shallowly fissured, although new branches are pale brown and hairy. Large, alternate, subsessile, stiff, coriaceous, elliptic, lanceolate to obovate, lanceolate in outline, 21-32cm 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 are fragrant, 1.2cm wide, and borne in woolly panicles that are 10-20cm long. The calyx has five tiny, imbricate, sharp teeth, and the corolla has five rectangular, ovate-clawed petals that are white in colour and delicate in texture. Fruits borne in clusters, 2.5-8cm in length, pale yellow to orange, slightly 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; seeds 4-10, brownish, oblong, 1-2cm long; skin about as thick as that of a peach, but slightly tougher; flesh firm and flesh There are several varieties of *E. japonica*. The Chinese groups have enormous, pyriform, deep orange fruit that ripens mid-season to late and may be stored for 1-2 weeks, whereas the Japanese groups have small, thin, light-colored fruit that matures early and has a shorter shelf life. The generic name comes from the Greek words 'erion' (wool) and 'botrys' (cluster), and refers to the spiky inflorescence's woolly look; the specific epithet means of Japan.

PHARMACOLOGICAL ACTIVITY

Anti-inflammatory Activity

Loquat seed and fruit have a considerable influence on inflammatory issues, according to Chinese traditional medicine¹³⁻¹⁵. Loquat juice was shown to be an efficient anti-inflammatory. In peritoneal macrophages, it showed a preventive effect against LPS-induced inflammation¹⁵. Inflammation has been linked to increased levels of pro-inflammatory cytokines such as interleukin-8 (IL-8), interleukin-1 (IL-1), tumour necrosis factor (TNF-), cyclooxygenase-2 (COX-2), and inducible nitric synthase (iNOS)¹⁶⁻²⁰. For a stronger anti-inflammatory impact of loquat extract, an increase in anti-inflammatory cytokines such as IL-10 and a decrease in pro-inflammatory cytokines is required¹⁹⁻²¹. When mice were given tormentic acid from a loquat suspension culture, there was a decrease in paw edoema and an increase in the activities of superoxide dismutase, catalase, and

glutathione peroxidase in the liver tissues²². Fruit juice was also observed to increase the release of anti-inflammatory cytokines like IL-10 in LPS-induced inflammation, as well as reduce the levels of pro-inflammatory mediators like IL-6, IL-1, and TNF- in peritoneal macrophages culture¹⁴.

Antidiabetic Activity

Diabetic mellitus is a hyperglycemia condition caused by an insulin action deficiency⁹. The fruit and seed of the loquat have also been shown to have an anti-diabetic impact and can help treat type 1 and type 2 diabetes²²⁻²⁹. When flavonoids and terpenes fractions of loquat extract were used to analyse hypoglycemic levels in streptozotocin (STZ)-induced and alloxan-induced diabetic mice, it was discovered that the triterpene fraction (300mg/kg/day) had a better hypolipidemic and hypoglycemic effect on normal, alloxan- and STZ-induced diabetic mice²⁴. In alloxan-diabetic mice, 30g/kg per dosage of total sesquiterpenes had the same hypoglycemic effect²². Furthermore, the flavonoid fraction (hyperoside, isoquercitrin, and rutin) had a comparable hypoglycemic effect at 300mg/kg in STZ-induced diabetic mice, lowering serum insulin and plasma glucose levels²⁴. In a high-fat diet-induced diabetes C57BL/6 J mouse model, a loquat cell suspension culture containing diverse terpenoids such as corosolic acid, ursolic acid, and tormentic acid was used, and the concentrations of leptin, insulin, and blood glucose were shown to be lower³⁰. Loquat seed hypoglycemic effect was seen in KK-Ay mice and Otsuka Long-Evans Tokushima Fatty (OLETF) rats (type 2 diabetes models) on a 10% powered diet, with findings showing a consistent drop in serum insulin concentration and blood glucose level compared to control animals²³.

Anticancerous Activity

Loquat extract has also been shown to have anti-cancer properties against a variety of cancer cell lines. Loquat extracts have been shown to inhibit cancer proliferation, initiation, and metastasis in a number of investigations³¹⁻³³. Hydrophilic loquat extracts suppress cancer cells *in vivo* in Meth-A-fibrosarcoma-bearing mice by immunomodulatory

action, for which interleukin-17, TGF-1, and interferon-gamma were responsible agents³²; however, further study is needed to reach a conclusion. In rats, both ethanol and water extracts of loquat inhibited tumour cell proliferation and the formation of breast cancer cells. Furthermore, the water fraction inhibited 7, 12-dimethylbenz[*a*]anthracene (DMBA)-induced breast cancer in rats better³³. Loquat extract displayed better antiproliferative capabilities and cytotoxicity in cell lines of carcinoma, cervical epitheloid (HeLa), lung (A549), and oestrogen receptor-negative breast cancer (MDA-MB-231) in a study of 14 medicinal herbs³⁴. Human lymphoid Molt 4B proliferation was significantly suppressed by oleanolic acid and ursolic acid derived from loquat. Another research found that 3-O-(E)-p-coumaroyltormentic acid induced cell death (apoptosis) in the HL60 line via the mitochondrial route, suggesting that it might be used to treat leukaemia in humans³⁵.

Hepatoprotective Activity

Loquat extracts have been demonstrated to preserve the liver³⁶. In a study, both 70 percent methanol and ethanol extracts of loquat seed significantly reduced the formation of liver fibrosis in hepatopathic rats, and loquat extract also reduced the concentrations of hydroxyproline, L-aspartate aminotransferase (AST), and L-alanine aminotransferase (ALT), as well as increasing the level of retinoids in dimethylnitrosamine-induced hepatopathic rats. Furthermore, loquat seed extract was found to protect against steatohepatitis (nonalcoholic). In the livers of rats, the seed extract (70 percent ethanol) reduced the levels of AST and ALT as well as the synthesis of lipid droplets. The inhibitory impact of fatty liver fibrosis and fatty liver is due to increased antioxidant enzyme activity³⁶.

Other Activities

Loquat extracts have been shown to protect many organs and systems, including the kidneys³⁶, the lungs³⁷ and neuronal cells³⁴. Loquat extracts have also been shown to be beneficial as an anti-allergic, anti-aging, anti-obesity, hypolipidemic³⁸, antithrombotic and antinociceptive agent³⁹.

Adriamycin has a number of adverse effects, including issues with the kidneys and liver. Experiments found that loquat seed extracts could treat adriamycin-induced hepatic renal disease in rats and that this anti-nephropathy action was due to loquat extract's antioxidant activity³⁶. Oxidative stress can cause neurodegenerative disorders. Loquat extract was discovered to have neuroprotective properties against A1-42-induced cell death and oxidative stress caused by A peptide. It also restored mice's alternation behaviour and inhibited lipid peroxidation, as well as reversing SOD. Because of the reduction in adipose tissue size in the visceral depot, body weight increase, hepatic triacylglycerol content, and white adipose tissue (WAT) weight, loquat cell suspension culture with terpenoids demonstrated antihyperlipidemic efficacy in HF diet mice. These antihyperlipidemic effects were linked to elevated phosphorylation of the AMPK- (Thr1) protein in both adipose tissue and the liver⁴⁰.

Antioxidant Activity

To ensure the potential of antioxidant activity of loquat fruit extracts in both in vivo and in vitro circumstances, a variety of antioxidant tests were used. Antioxidant assays such as the 2, 2'-azino-bis-(3-ethylbenzothiazoline-6-sulfonate (ABTS) assay, the ferric reduction antioxidant power assay (FRAP), the 1, 1-diphenyl-2-picrylhydrazyl radical (DPPH) assay, the Trolox equivalent antioxidant capacity (TEAC) and the total antioxidant capacity were used to assess the antioxidant potential of loquat fruit and seed extracts, which showed The antioxidant activity of loquat fruit from different cultivars and nations differed, indicating the impact of the environment and genetic background on antioxidant accumulation^{41,42}. Total phenolics and antioxidant activity of loquat fruit cultivated in China⁴³ and Turkey⁴⁴ were shown to have a stronger correlation. Because of its increased phenolic content, loquat extracts demonstrated stronger DPPH activity than pulp and peel extracts²¹. Water, methanol, and n-butanol fractions of loquat seed extract containing polyphenols exhibited stronger radical scavenging activity, whereas ethyl acetate

and low-polar-n-hexane fractions of loquat seed extract containing -sitosterol showed superior prevention of lipid peroxidation⁴⁵. Furthermore, loquat seed extracts were shown to be beneficial against linoleic acid oxidation and low-density lipoprotein oxidation. Loquat fruit extracts reduced ROS in a variety of cell types. Loquat fruit extract inhibited ROS in erythrocytes and leukocytes when induced by chloramphenicol⁴⁶.

Anti-metastatic Activity

Roseoside isolated from loquat was identified as the main component that inhibited the proliferation of malignant cells driven by peroxynitrite as an initiator in a study of two-stage carcinogenesis on mouse skin. When mice tumours were activated by initiator (7, 12-DMBA) and promoter (TPA), euscaphic acid was revealed to be a better anticancer agent⁴⁷. Furthermore, loquat seed extract was found to be a potent anti-metastatic agent, preventing melanoma cells (B16F10) and human breast cancer cells (MDA-MB-231) from invading and migrating²⁴. MMP-9 and MMP-2 activity were significantly suppressed by a loquat extract containing 2-hydroxyursolic acid and ursolic acid⁴⁸⁻⁵¹.

Antibacterial Activity

The bioactive chemicals in loquats may have antibacterial properties. ESBL-producing *Klebsiella pneumoniae* and *Escherichia coli* were suppressed by loquat extracts⁵².

Antiviral Activity

Pomolic acid and oleanolic acid, two bioactive chemicals found in loquats, were anti HIV drugs that aided in the treatment of AIDS⁴⁸. Loquat's 2-alpha-hydroxyursolic acid was also discovered to be efficient against the HIV virus⁵².

Antiaging Activity

In vitro, loquat extract was reported to be helpful against ageing by slowing cellular ageing in rat fibroblasts. Seven days of treatment with loquat extract improved bradykinin (BK)-induced Ca²⁺ dynamics in senescence cells and protected them from ageing, just as it did in young cells.

Antineutrophil Elastase Activity

The inhibitory impact of loquat leaves extract (triterpenoids composition of loquat leaves, TCLL) and ursolic acid (UA) on human neutrophil elastase (HNE) *in vitro* and therapeutic efficacy on acute lung injury (ALI) in mice were compared. In comparison to the control group, TCLL enhanced inflammatory cells and cytokine production in mice. Furthermore, IC₅₀ values revealed that TCLL (3.26 0.56g/mL) inhibited HNE more effectively than UA (8.49 0.42g/mL)⁴⁹.



Figure No.1: *Eriobotrya japonica* (from google.com)

CONCLUSION

The main pharmacological actions found and the key bioactive components described in different sections of loquat were the focus of this review. The primary ingredients of loquat have been identified as tannin, quercetin, chlorogenic acid, ursolic acid, oleanolic acid and caffeic acid, according to phytochemical research. *Eriobotrya japonica* has been shown to exhibit a variety of pharmacological effects, including antioxidant, antibacterial, hypolipidemic, anti-diabetic, and other properties. The wide scope range is accessible for researchers to analyse and study the medical benefits of the medications.

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Anti-osteoclastogenesis Activity

The anti-osteoclast potential of ursolic acid was investigated. Polymer-coated nanobeads were employed in this study, and nuclear exporter protein (XPO5) was identified as a target protein for inhibiting osteoclast development (P 0.01). As a result, a microRNA expression analysis found that ursolic acid had a considerable influence on osteoclast differentiation, with an IC₅₀ value of 5.4 0.96M⁵⁰.

CONFLICT OF INTEREST

We declare that we have no conflict of interest.

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