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An overview of the loquat's (Eriobotrya japonica) active components

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Abstract:

The variety known as loquat (*Eriobotrya japonica* (Thunb.) Lindl.) is subtropical in nature. The primary cultivators of loquat are China and Spain. It has a substantial nutritional composition, that is high in minerals, organic acids, vitamins, and carbohydrates. Moreover, a variety of bioactive substances, including flavonoids, triterpenoids, carotenoids, and phenolics, are abundant in loquat. These substances exhibit various biological properties, including cytotoxic, hypolipidemic, hypoglycemic, antioxidant, and antitumor properties. Numerous investigations carried out in vitro and in vivo have shown that loquat may have health benefits. To establish a link between the bioactive compounds and their biological activities, more research is necessary, thereby augmenting our understanding of the properties of this plant.

Keywords: Eriobotrya japonica, Loquat, Active compounds, Biological activities, Medicinal plants.

Introduction:

Loquats are members of the Rosaceae family and the Pomoideas subfamily, collectively known by their scientific name, *Eriobotrya japonica* Lindl. The origins of it are located in the southwest region of China. The Japanese plum tree, another name for this plant, is gaining popularity. The loquat fruits are widely distributed, occurring in many parts of the Asian continent and Mediterranean region . Moreover, loquat is found in the Americas specially in USA. (Gong *et al.*, 2015).

This species has the potential to reach a height of up to 10 meters. However, in cultivated regions, it tends to be smaller, typically around 3-4 meters. The canopy of the loquat tree has a rounded shape, while its branches are covered in a velvety texture. The leaves are simple in structure and have an elliptic-lanceolate format. They possess a rigid texture and a serrated border. The size of these leaves typically ranges from 10 to 25 centimeters. The upper face of the leaves exhibits a distinct dark green coloration, while the underside appears white or rusty. The flowers of the loquat tree have a diameter of approximately 2 centimeters. They are white in color, emit a sweet fragrance, and consist of five petals. These flowers are clustered together in bunches of three to ten. Prior to blooming, they

possess a velvety texture (Delucchi *et al.*, 2010).

Some of the various fruits, the loquat flower ripens in early spring or late winter, and it blooms unusually in early winter or autumn (Delfanian *et al.*, 2015). These days, the loquat fruit is not only eaten raw but also used to make jam, chutney, and jelly (Koba *et al.*, 2007). The cultivation of loquat primarily revolves around fruit production and its incorporation in Chinese classical medicine, with the utilization of its leaves also being observed (Ahumada *et al.*, 2017).

Numerous studies have demonstrated the remarkable medicinal properties of loquat, including their capacity to reduce blood sugar, antiviral infections, antitumors, reduce inflammation, reduce cytotoxicity, prevent mutagenic growth, and lower cholesterol (Baljinder *et al.*, 2010).

Figure 1: loquat tree

Active Compounds in Eriobotrya japonica:

Loquat possesses a substantial abundance of diverse bioactive compounds; nevertheless, their concentration exhibits variability across different varieties. The main bioactive substances include triterpenic acids, carotenoids, and flavonoids (phenols) (Kumar and Pallavi, 2014).

- **Flavonoids (Phenols):**

Phenolics potentially comprise the most extensive assemblage of plant secondary metabolites. They exhibit a shared attribute of harboring one or more phenol groups, while their structural diversity ranges from uncomplicated arrangements featuring a singular aromatic ring to exceedingly intricate polymeric substances (Goławska *et al.*, 2014). These compounds are distinguished by their possession of antioxidant, anti-inflammatory, anti-carcinogenic, and various other biological properties, thereby potentially conferring protection against oxidative stress and certain ailments. The deterrent abilities of phenolic compounds enable them to safeguard plants from herbivory, pathogen assault, and other animal threats. Furthermore, their elevated concentration endows plants with enhanced fungal resistance (Kabera *et al.*, 2014).

The concentrations of phenolic acids as well as flavonoids in locoquat are 30% and 60%, respectively. The primary phenolic compounds found in loquat encompass chlorogenic acid and neochlorogenic acid. Naturally all the flavonoids that have been isolated, flavonol-O glycoside is one that is especially significant from the loquat. It is worth noting that a greater abundance of phenolic compounds correlates with a heightened level of antioxidant activity (Ju *et al.*, 2003).

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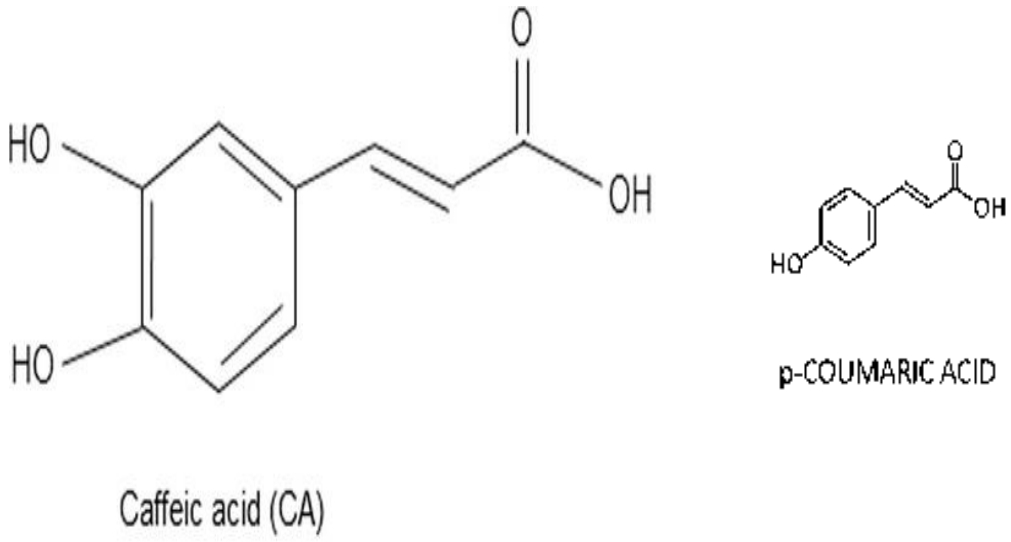

Figure 2: Examples of phenols in loquat.

- **Carotenoids:**

Carotenoids play significant roles in biological processes, serving as agents with antioxidative properties, and enhancers of immunity. Carotenoids with a polyene side chain, such as β-carotene, α-carotene, β-ionone ring and β-cryptoxanthin, are referred to as provitamin A because they act as precursors to vitamin A. The condensation of eight isoprene units of C5 yields these carotenoids. Most carotenoids range in color from yellow to deep red, but some, like phytofluene and phytoene, are colorless. The pigmentation of ripe fruits, including loquat, is primarily due to these colored carotenoids (Zhou *et al.*, 2007; Sagar *et al.*, 2020).

The carotenoid content of loquat flowers was approximately twenty-five μg/g DW, with a third and a fourth of the total concentration coming from the two main carotenoids, respectively. The concentration of carotenoid increased in loquat leaves initially and reached a higher level one hundred fifty μg/g FW at maturity. It was discovered that the main components of the total carotenoid content in the leaves were lutein, β-carotene, and violadexanthins, which made up ten percent, twenty-five percent, and forty percent of the carotenoid content, respectively (Li *et al.*, 2016).

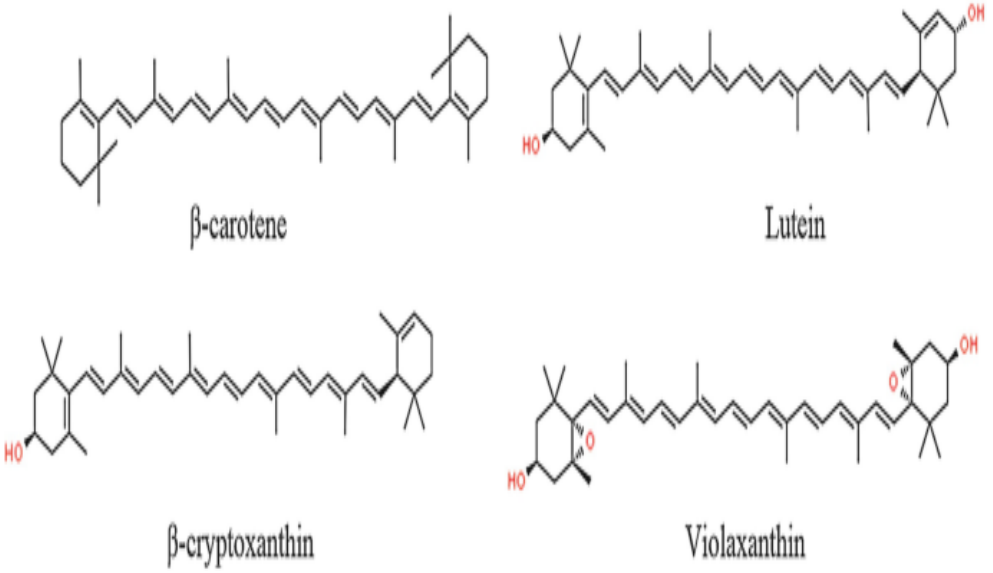

Figure 3: Some carotenoids are prominent in loquat fruit.

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- **Triterpenoids:**

Terpenes represent the most extensive and diverse assemblage of plant secondary compounds. This group comprises more than forty thousand structurally diverse compounds and makes up the largest class of plant metabolites (Bohlmann and Keeling, 2008). The term "terpene" or "terpenoid" was chosen due to the fact that its initial member was isolated from turpentine oil (Ahmed *et al.*, 2017).

Some of the ingredients include floral fragrance, which attract insects, as well as growth inhibitors, pine oil, the plant hormonal substances gibberellic acid and abscisic acid, and specific insecticides. The presence of repeating five-carbon isoprene units is a common feature among identified terpenes (Teoh, 2015).

Terpenes are categorized based on the quantity of five-carbon isoprene units they contain. Hemiterpenes C5 to polyterpenes >C40, all have been part of this classification system (Ghorbanpour *et al.*, 2017).

Oleanolic acid (OA) and ursolic acid (UA) are the two primary triterpene acids present in loquat fruit. Loquats contain a high concentration of pentacyclic isomeric triterpenoids. Through analysis of loquat flowers, it was observed that different cultivars had a negligible impact on these two triterpenoids with a pentacycle (Zhou *et al.*, 2007).

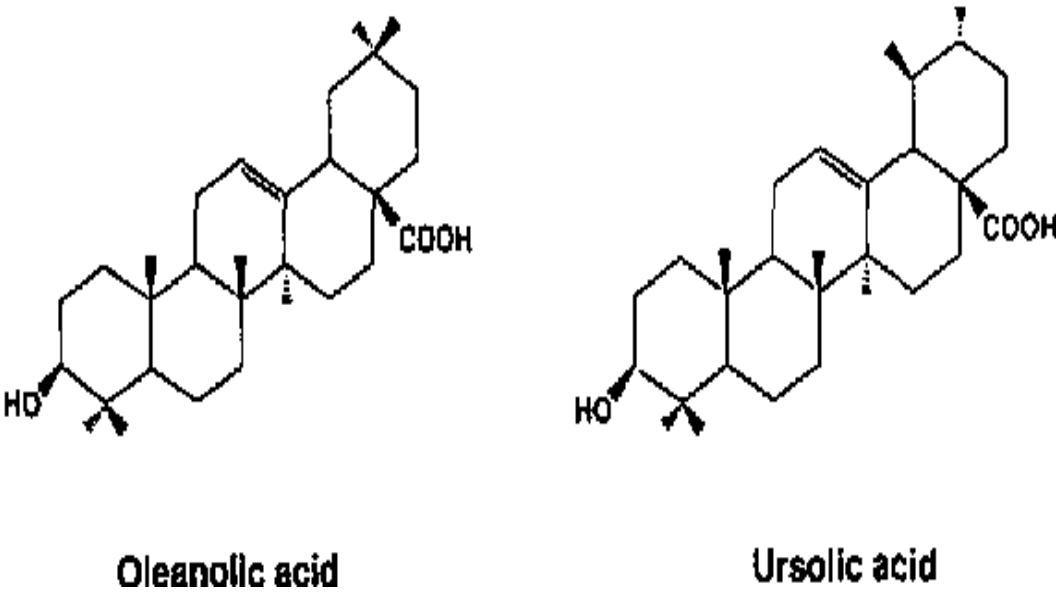

Figure 4: The chemical composition of the triterpenoids present in loquat

- **Other Active Substances:**

Hasegawa et al. (2010) found loquat also contains volatile compounds, dietary fibers, and vitamins. It has been reported that the vitamin C content of five Brazilian loquat cultivars ranged from 5.28 grams per /100 g FW to 8.20 grams per /100 g FW.

Furthermore, an analysis of 44 different types of loquat showed an average vitamin C content of about seven mg/100 g; the lowest and highest concentrations of vitamin C were recorded at 3.35 mg/100 g and 25 mg/100 g, respectively (Wei *et al.*, 2009).

Forty-nine volatile compounds were found in loquat after further analysis using gas chromatography-mass spectrometry and headspace-solid stage micro extraction methods. Phenylethyl alcohol had the highest concentration of these compounds. Caprylic acid, methyl benzoate, 16 alkyl, acetic acid, anisic aldehyde, propionic acid, and benzaldehyde had the lowest concentrations. It was found that the distinctive fragrance of the loquat flower consisted of five

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acids, six alcohols, six esters, and six aldehydes, accounting for sixty-three percent of the volatile compounds (Zhang *et al.*, 2008).

Biological Activities of Loquat:

Bioactive compounds have a variety of health benefits and potential biological roles, including anti-inflammatory properties, anti cancer, anti-oxidants, hypoglycemic, antiviral properties, antimutagenic, cytotoxic, and hypolipidemic properties (Bahedh and Al-Habib, 2020; Jassim, 2022). Loquat's biological activity in both in the in vitro and in vivo conditions has been supported by numerous studies. (Yin and Chan, 2007).

- **In Vivo:**

In regards the antioxidant activity that animal models have shown, the utilization of loquat seed extracts has resulted in a noteworthy decline in reactive oxygen species (ROS) within rats suffering from adriamycin-induced nephropathy. Furthermore, this intervention has exhibited a reduced presence of lipid peroxides within plasma and a decrease in glutathione concentration found within renal tissues (Hamada *et al.*, 2004). Furthermore, it has been discovered that applying loquat seed extract to the liver cells of rats with nonalcoholic steatohepatitis increases antioxidant enzyme activity while decreasing the incidence of lipid peroxidation (Yoshioka *et al.*, 2010).

- **In Vitro:**

The anti-inflammatory characteristics of the n-butanol fraction isolated from loquat leaves were demonstrated by inhibiting nitric oxide synthase expression and nitric oxide production. This was accomplished by reducing nuclear factor-κB (NFκB) activation.

Furthermore, the fraction inhibited the expression of cyclooxygenase-2 and pro-inflammatory cytokines like tumor necrosis factor-α (TNF-α) and interleukin-6 in a mouse model of peritoneal macrophages stimulated by lipopolysaccharide (LPS) (Cha et al., 2011).

According to Shafi et al., (2019) Eriobotrya japonica's ethanol fruit extract, which was produced by macerating the fruit for 48 hours, exhibited significant hypolipidemic activity in streptozotocin-stimulated diabetic rats.

After two hours of hot extraction, the ethanol and aqueous extracts of falling and growing loquat leaves demonstrated expectorant and antitussive properties. The ethanol extract of fallen leaves, on the other hand, had a stronger antitussive effect. This could be due to the presence of more triterpenoids, such as ursolic acid, tormentic acid, corosolic acid, and maslinic acid. Contrarily, the growing leaves' aqueous extract showed a stronger expectorant effect. This could be because it contained more flavonoids, such as rutin, hyperoside, isoquercitrin, and quercitrin, etc. (Wu *et al.*, 2018).

The ethanol extract of loquat leaves, in a rat model of bleomycin-induced pulmonary fibrosis, obtained by cold extraction for two hours, demonstrated antifibrosis activity by reducing fibrosis and improving lung structure. Triterpenic acids found in the extract were thought to be responsible for this activity (Yang *et al.*, 2012; Nyif, 2018).

Conclusions:

Flavonoids, carotenoids, and triterpenoids are just a few of the many bioactive substances found in loquats. These compounds are physiologically active and offer protection against a variety of liver, brain, and lung-related illnesses. Numerous studies conducted in vitro and in vivo on rats and various cell lines have documented the beneficial effects of loquat. Although more research is still needed, it demonstrated anti-inflammatory, antibacterial, antidiabetic, and antiviral effects.

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