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A REVIEW ON *LITCHI CHINENSIS*

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ABSTRACT: Litchi (*Litchi chinensis Sonn*.) is a widely cultivated tropical fruit, enjoyed globally for its delicious taste, vibrant color, and high nutritional value. Beyond its culinary appeal, litchi has been used in traditional Chinese medicine for centuries to treat various ailments, including stomach ulcers, diabetes, and digestive issues. Herbal medicines have played a vital role in traditional healing practices, such as Ayurveda and homeopathy, offering effective treatments and cures for a range of diseases and physiological conditions. Recent studies have unveiled the fruit's impressive range of health benefits, including antioxidant, anti-inflammatory, and anti-cancer properties, attributed to its rich composition of polysaccharides and polyphenols. However, consumption of litchi can also lead to adverse reactions in some individuals, likely due to its soluble protein content. This review aims to provide an overview of litchi's nutrient profile, health benefits, and safety considerations, highlighting its potential applications in the food, medical, and cosmetics industries.

INTRODUCTION: Medicinal plants have been a primary source of treatment for human diseases since ancient times. Herbal medicines are considered a promising alternative to modern synthetic drugs. They have minimal or no side effects and are regarded as safe [1]. Litchi (*Litchi chinensis*), a member of the Sapindaceae family, is grown in tropical and warmer subtropical regions worldwide and is highly valued commercially for its delicious fruit and nutritional benefits (Zhao *et al.*, 2020) [2]. Originally grown in southern China and northern Vietnam, litchi is now cultivated in more than 20 countries around the world [3]. Litchi fruits are delicious and succulent, featuring an attractive red color, delightful taste, and sweet aroma.

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They are arillate fruits with sweet, juicy, white, and translucent flesh that surrounds a single large seed [4]. Lychee flowers are classified into three types: staminate, pistillate, and imperfectly hermaphroditic. These flowers appear consecutively on the same panicle in two distinct sequences [5]. The primary commercial litchi industries are located in China, Taiwan, Vietnam, Thailand, India, Bangladesh, Nepal, Madagascar, and South Africa. Smaller industries can be found in the Philippines, Indonesia, Australia, Mauritius, Israel, the USA, Brazil, Mexico, the Canary Islands, Reunion, Zimbabwe, and Mozambique [6]. The fruit, seeds, leaves, and pericarp of lychee are rich in phytochemicals such as flavonoids, phenolics, and triterpenoids [7].

Previous studies have shown that the major flavonoids in litchi pericarp include epicatechin, epicatechin gallate, rutin, quercetin 3-O-glucoside, and procyanidins B4 and B2. In contrast, the primary flavonoids in litchi seeds are epicatechin, procyanidins A1 and A2, rutin, phlorizin, tamarixetin 3-O-rutinoside, and litchioside D [8].

These compounds have garnered attention in pharmacognosy and phytochemistry due to their demonstrated antioxidant, anti-inflammatory, anticancer, and antibacterial properties [7]. Other pharmacological effects of bioactive compounds from litchi include anti-inflammatory, anti-tumor, anti-diabetic, anti-hyperlipidemic, anti-hyperglycemic, anti-hypertensive, anti-viral activities, and immunomo-dulatory effects [9].

FIG. 1: *LITCHI CHINENSIS* FRUITS

FIG. 2: *LITCHI CHINENSIS* SEEDS

FIG. 3: *LITCHI CHINENSIS* LEAVES

FIG. 4: *LITCHI CHINENSIS* FLOWERS

FIG. 5: *LITCHI CHINENSIS* TREE

Taxonomical Classification [10]:

TABLE 1: TAXONOMICAL CLASSIFICATION OF *LITCHI CHINENSIS*

Kingdom	Plantae
Order	Sapindales
Family	Sapindaceae
Sub-family	Sapindaceae
Genes	Litchi
Species	*L. chinensis*
Common name	Nephelium litchi

Synonyms [11, 12]:

- *Corvinia litchi* Stadm. ex-Willem.
- Euphoria lit-chi Desf.
- *Litchi chinensis* var. euspontanea H. H. Hsue
- *Litchi litchi* Britt.

- *Nephelium chinense* (Sonnerat) Druce
- *Sapindus edulis* Aiton
- *Scytalia chinensis* (Sonnerat) Gaertn.
- Scytalia litchi Roxb [11].
- *Dimocarpus lichi* Loureiro
- *Nephelium litchi* (Desf.) Cambessèdes
- *Euphoria didyma* Blanco
- *Litchi philippinensis* Radlk.
- Glomeriflora Radlk [12].

Vernacular Names [12]:

TABLE 2: VERNACULAR NAMES OF *LITCHI CHINENSIS*

Language	Names
Brazil	Lichia
German	Litchi, Litschi, Litchipflanze, Litschipflaume, Litschibaum
Greek	Litsi
Malaysia	Kelengkang, Laici
Thai	Lin Chi, Lin Chi Pa, Si Raman, Si Raman Kha
French	Cerisier De Chine, Litchi, Litchi De Chine, Litchie, Litchier
Chinese	Li Zhi (Li Chi), Li Zhi Guo, Ma Gie
Dutch	Lychee
Indonesia	Mengkuris, Kalengkang, Kelengkang, Laici, Lici, Litsi
Italian	Litchi
Japanese	Reishi
Spanish	Lechia, Mamoncillo Chino

Distribution: Litchi, native to southern China, has been cultivated for centuries (Huang and Xu, 1983). By the 16th and 17th centuries, it had spread to other tropical and subtropical regions [13]. In addition to China and India, litchi is successfully cultivated in regions such as the West Indies, Brazil, Honduras, Hawaii, Madagascar, Southern Japan, Spain, Mexico, Northeastern Australia, the Southern United States, Israel, Thailand, New Zealand, Mauritius, Taiwan, Myanmar, Bangladesh, and Nepal. In India, the primary litchi-producing states include Bihar, Uttarakhand, West Bengal (Murshidabad, 24-Paraganas), Assam, Punjab (Gurdaspur, Pathankot), Uttar Pradesh (Saharanpur, Muzaffarnagar, Meerut, Kushinagar), Jharkhand, and Tripura [14].

Food Value: While the leaves and branches of certain trees in this family are toxic, others produce edible fruits that are highly valued for their flavor and nutritional benefits. Notably, the litchi nut, longan, and rambutan fruits are prized for their excellent taste and are also used in traditional medicine to treat inflammatory and bilious fevers. The extracts obtained from the fruit were acidic in nature, containing citric acid and potentially other common fruit acids. These acids are known to stimulate appetite and provide relief from thirst. Although the fruit lacked pectin, its high sugar and acid content make it an ideal candidate for jelly production, especially when combined with orange fruit. This jelly would be particularly suitable for individuals with nephritis or those requiring a restricted diet to reduce urine acidity [15].

Ethnomedical uses: *Litchi chinensis* Sonn. (Sapindaceae) is a highly valued plant in traditional medicine, used to treat various ailments, including cough, digestive issues, diabetes, obesity, and pain. Its rich ethnopharmacological history reveals a broad spectrum of biological activities, including: Hypoglycaemic (blood sugar regulation), Anticancer, Antibacterial, Anti-hyperlipidaemic (cholesterol regulation), Anti-platelet (blood clot prevention), Anti-tussive (cough suppression), Analgesic (pain relief), Antipyretic (fever reduction), Haemostatic (bleeding control), Diuretic (urine production), Antiviral. These multifaceted properties underscore the potential of *Litchi chinensis* as a valuable natural remedy [16].

Phytochemical Constituents: A phytochemical analysis was conducted to identify the phytoconstituents present in the extracts using standard qualitative methods. The analysis screened for various biologically active compounds, including alkaloids, carbohydrates, glycosides, insulin, proteins and amino acids, steroids and triterpenoids, fats and oils, as well as tannins and phenolic compounds, Flavonoids, Gums and mucilage, Naphthoquinones. This comprehensive analysis aimed to identify the diverse range of bioactive compounds present in the extracts [17].

Isolated Compounds:

Leaves: The leaves contain compounds such as (-) -Epicatechin, procyanidin A2, and procyanidin B2.

Fruit: The fruits contain a 5-hydroxymethyl-2-furfurolaldehyde (5-HMF), benzyl alcohol, hydrobenzoin, and (+) – catechin.

Seed: The *Litchi chinensis* seed contains Leucocyanidin, cyanidin glycoside and malvidin glycoside, and saponins.

Pericarp: The pericarp contains compounds 5-2-(2-hydroxy-5- (methoxy carbonyl) phenoxy) benzoic acid, bis-(8-epicatochinyl) methane, butylated hydroxy toluene, epicatechin, dehydrodiepicatechin A, methyl shikimate, ethyl shikimate, isolariciresinol, kaempferol, methyl 3,4-dihydroxy benzoate, proanthocyanidin A1, A2, rutin, and stigmasterol [18].

Nutritive/Medicinal Properties: The nutrient composition of raw litchi, with 40% refuse from shell and seed excluded, per 100 grams of the edible portion.

TABLE 3: MEDICINAL PROPERTIES OF *LITCHI CHINENSIS* PER 100 GRAMS OF THE EDIBLE PORTION

Sl. no.	Composition	Quantity
1	Water	81.76g
2	Energy	66 kcal
3	protein	0.83 g
4	Fat	0.44 g,
5	Ash	0.44g
6	Carbohydrate	16.53gm
7	Dietary fibre	1.3gm
8	Riboflavin	0.065 mg
9	Vitamin C	71.5 mg
10	Thiamine	0.011 mg
11	Niacin	0.603 mg
12	Vitamin B6	0.100 mg
13	Total folate	14 mg
14	Choline	7.1 mg
15	Calcium	5 mg
16	Iron	0.31mg
17	Lysine	0.041g
18	Methionine	0.009 gm
19	Magnesium	10 mg
20	Vitamin K	0.4 mg

Another analysis revealed the proximate composition as follows:

A total of 96 volatile compounds were detected in lychee fruit, 43 of which were successfully identified. Seventeen common volatiles found in all samples included linalool, cis-rose oxide, α-terpineol, β-citronellol, geraniol, p-cymene, ethanol, 3-methyl-3-buten-1-ol, 3-methyl-2-buten-1-ol, 1-hexanol, (E)-2-hexen-1-ol, 2-ethyl-1-hexanol, 1-octen-3-ol, 1-octanol, ethyl acetate, p, α-dimethyl styrene, and 3-tert-butyl-4-hydroxyanisole.From the lychee tree, particularly its fruit pericarp and seeds, possesses numerous pharmacological properties such as Antioxidant Activity, Anticancer Activity, Hepatoprotective Activity, Antiviral Activity, Antiplatelet Activity, Antihyperlipidemic Activity, Antidiabetic Activity, Anti-inflammatory Activity, Antimutagenic Activity [11].

TABLE 4: ANALYSIS REVEALED THE PROXIMATE COMPOSITION OF *LITCHI CHINENSIS*

Sl. no.	Composition	Quantity
1.	Energy	296 kJ
2	protein	1.1g
3	Fat	0.1g
4	Ash	0.3g
5	Moisture	80.6g
6	Dietary fibre	1.3g
7	Riboflavin	0.07 mg
8	Vitamin C	49 mg
9	Thiamine	0.05 mg
10	Niacin	0.5 mg
11	zinc	0.6 mg
12	Total sugars	16.2g
13	Fructose	7.6 g
14	Glucose	7.9 g
15	Sucrose	0.7 g
16	Malic acid	0.4 g
17	Iron	0.5 mg

Pharmacological Activities:

Hepatoprotective Activity: The pulp extract of *Litchi chinensis* was assessed for its vitamin C and phenolic content, anti-lipid peroxidation activity, and hepatoprotective effects. In a study conducted on male Wistar albino rats, the animals were intraperitoneally injected with CCl_4 (2 ml/kg) and then orally administered with silymarin (100 mg/kg) or *Litchi chinensis* (100 mg/kg and 500 mg/kg). After 10 days, the rats were sacrificed, and their livers were examined both histopathologically and immunohistochemically. Serum levels of glutamate-pyruvate transaminase, glutamate-oxalate transaminase, and alkaline phosphatase were assessed. Liver apoptotic activity was assessed quantitatively. The antioxidant properties of *Litchi chinensis*, attributed to its vitamin C and phenolic compounds, may account for its anti-lipid peroxidation and antiapoptotic effects, contributing to its hepatoprotective action in CCl_4-induced hepatotoxicity [19].

Anti-inflammatory and Analgesic Activity: The potential of hydroalcoholic extract of *Litchi chinensis* leaves (HLCL) was evaluated for its anti-inflammatory and analgesic effects at three different dosage levels. Preliminary phytochemical analysis of the extracts revealed the presence of terpenoids, flavonoids, phenols, tannins, and saponins. The anti-inflammatory activity was evaluated using the carrageenan-induced inflammation model paw edema model in rats, while analgesic activity was tested using the acetic acid-induced writhing test and the hot plate method in mice. Oral administration of HLCL significantly reduced inflammation, with the greatest effect observed 4 hours after carrageenan administration. Comparable results were observed in the hot plate test, demonstrating significant analgesic activity [20].

Cardiovascular Activity: Lychee-flower-water extract (LFWE), which contains phenols, flavonoids, and tannins, was studied in ten male hamsters randomly assigned to one of the following dietary groups: chow diet with normal distilled water (LFCD/NDW), and high-fat/cholesterol diet with normal distilled water. In hamsters on the high-fat/cholesterol diet, LFWE helped normalize LDL receptor gene expression, downregulated FAS gene expression, and upregulated peroxisome proliferator-activated receptor alpha (PPAR-α) gene expression. Additionally, LFWE enhanced the serum's total Trolox equivalent antioxidant capacity (TEAC) and reduced lipid peroxidation, as indicated by lower malondialdehyde (MDA) levels in the hamsters [21].

Antilipase Activity: The aqueous extract of *Litchi chinensis* flowers is rich in various phytochemicals, including phenolic acids, flavonoids, condensed tannins, anthocyanins, and proanthocyanidins. The study aimed to assess the anti-lipase effects of 2.5% and 5% LFWE in rats induced with a hypercaloric diet for 10 weeks. The results demonstrated that LFWE inhibited in vitro lipase activity and reduced liver size as well as perirenal and epididymal adipose tissue in the 5% LFWE-treated groups. Rats fed a hypercaloric diet exhibited elevated serum cholesterol and liver lipid levels; however, treatment with LFWE reduced these levels to values comparable to those of the control group. These findings aligned with the liver tumour necrosis factor alpha hypercaloric diet-fed rats treated with LFWE. The study concluded that LFWE has potential as a nutraceutical for anti-obesity effects [22].

Aldose Reductase Activity: *Litchi chinensis* fruit extracts demonstrated strong in vitro inhibition of rat lens aldose reductase (RLAR), with both methanolic and ethanolic organic fractions exhibiting significant activity. From the active ethanolic fraction, four minor compounds with diverse structural characteristics were isolated and identified as D-mannitol, 2,5-dihydroxybenzoic acid, delphinidin 3-O-β-glucoside, galacto-pyranoside-39, 59-di-O-β-glucopyranoside, and delphinidin 3-O-β-galactopyranoside-39-O-β-glucopyranoside. Among these, delphinidin 3-O-β-galactopyranoside – 39 – O – β - glucopyranoside exhibited the strongest inhibition of RLAR, suggesting its potential for preventing and/or treating diabetic complications [23].

Antioxidant Activity of Polysaccharide Enriched Fractions: The antioxidant properties of four different polysaccharide fractions derived from *Litchi chinensis* were assessed through a series of in vitro assays. These polysaccharide-enriched fractions demonstrated dose-dependent free radical scavenging activity, as evidenced by their ability to inhibit DPPH radicals, superoxide anions, and hydroxyl radicals, along with their chelating ability and reducing power. Among the fractions, LFP-III exhibited the strongest scavenging activity against DPPH radicals, superoxide, and hydroxyl radicals, as well as the highest chelating ability. This evaluation provides valuable insights into the potential of lychee fruit polysaccharides as functional antioxidants due to their significant antioxidant activity [24].

Anticancer Activity: Lychee fruit pericarp extract exhibited a potent inhibitory effect on the proliferation of both estrogen receptor (ER) positive and negative breast cancer cells in vitro, as well as on tumorGrowth of ER-negative breast cancer in humans was observed in vivo.The extract suppressed cell proliferation and triggered apoptosis by upregulating genes such as *CYP1A1* and *ADPRTL1*, while downregulating genes including *BIRC3*, *ADAM9*, and *HMMR*. These genes are involved in various processes, including cell cycle regulation, cell proliferation, apoptosis,

signal transduction, transcriptional regulation, and the motility and invasiveness of cancer cells [25].

Anti-oxidant Activity: The acetone extract of *Litchi chinensis* flowers exhibited notable DPPH radical scavenging activity and inhibited low-density lipoprotein (LDL) oxidation, effects linked to its phenolic compound content. This antioxidant-rich extract was dissolved in water and sequentially partitioned with n-hexane, ethyl acetate (EA), and n-butanol. The EA fraction, which contained the highest levels of phenolic compounds and antioxidant activity, was further purified through silica gel column chromatography. The major compounds isolated by semipreparative high-performance liquid chromatography (HPLC) were (−)-epicatechin and proanthocyanidin A2, identified using mass spectrometry (MS) and nuclear magnetic resonance (NMR). This study represents the first attempt to uncover the antioxidant components of lychee flowers [26].

Diabetic Activity: Litchi seed extracts (LSEs) have been reported to inhibit protein tyrosine phosphatase 1B activity, helping to reduce postprandial hyperglycemia. LSE contains catechin-related compounds, including pinocembrin glycosides, 3,5-dihydroxybenzoic acid, scopoletin, and rutin. These glycosides function as anti-diabetic and antiglycation agents in the management of type 2 diabetes (T2D) in rats, with LSE showing hypoglycemic effects through the inhibition of glycogenesis, proteolysis, and lipogenesis. Considering the beneficial properties of litchi seeds, they could become a cost-effective and sustainable ingredient in the food industry, as well as a promising strategy for managing diabetes management in the pharmaceutical industry [27].

CONCLUSION: *Litchi chinensis* is a significant medicinal plant with traditional importance, as evidenced by numerous experiments and scientific studies. Medicinal plants have long been central to global healthcare, serving as the foundation of health practices throughout history. *Litchi chinensis* offers a variety of therapeutic benefits, including antioxidant, antimicrobial, anti-inflammatory, anti-aldose, anti-ulcer, anti-lipase, and anti-diabetic activities, among others. While the major pharmacological effects of the plant have been reported through extracts, the specific active principles behind these activities remain to be explored further. This review outlines the general properties and medicinal benefits of *Litchi chinensis*, along with its wide range of pharmacological activities, providing valuable insights for researchers pursuing further studies on the plant.

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