

Tranditional Use and Nutritional Value of *Lansium domesticum*

Subjects: Tropical Medicine

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Lansium domesticum (Langsat, Meliaceae) is a tropical fruit mainly found in Southeast Asian countries, particularly in Thailand, Malaysia, Indonesia, and the Philippines.

Keywords: *Lansium domesticum* ; Meliaceae ; traditional uses ; nutritional value

1. Introduction

Fruits, vegetables, and medicinal herbs are the richest sources of health-promoting compounds such as vitamins, β -carotene, minerals, flavonoids, phenolics, and polyphenolics that exert significant bioactivities ^{[1][2]}. Genus *Lansium* belongs to the Meliaceae family, which includes about 560 species and 50 genera that are widespread in tropical and subtropical regions ^[3]. Genus *Lansium* commonly recognized species are *Lansium brevircemosum* Kosterm., *L. membranaceum* (Kosterm.) Mabb., and *L. domesticum* Corrêa. ^[4]. This genus is represented by only one species, *L. domesticum*, in Peninsular Malaysia ^[4]. While in Java, it is represented by two species; *L. domesticum* Corrêa and *L. humile* Hassk., as well as a variety *L. domesticum* var. *pubescens* Koorders et Valetton have been recognized ^{[5][6]}. *L. domesticum* is a common evergreen Southeast Asian tree that occurs both in the wild or cultivated in these regions, where it represents one of the commonly cultivated fruits ^[7]. It has high market potential and adequate economic value in Southeast Asian countries. Thailand, Malaysia, Indonesia, and the Philippines are considered to be the main producers of *L. domesticum*. Additionally, the plant is cultivated in Burma, Vietnam, Puerto Rico, Sri Lanka, India, Hawaii, Surinam, and Australia ^{[5][8][9]}. *L. domesticum* Correa is a complicated aggregate species of different plant forms. It's four prevalent types are Duku, Dokong (longkong), Duku-langsat, and Langsat. Duku and Langsat are the two most common types. Duku-langsat, Langsat, and Duku are domestic to Peninsular Malaysia, however, Dokong is found in southern Thailand and has been cultured in Peninsular Malaysia for >10 years ^{[5][7]}. The Duku-langsat is an intermediate type, it is conventionally regarded as uppermost type to both Duku and Langsat ^{[4][7]}. *L. domesticum* includes two botanically distinct varieties; var. *pubescens* and var. *domesticum* (**Table 1**) ^[10].

Table 1. Characteristics of the major distinct forms and varieties of *L. domesticum*.

Forms/Variety	Botanical Characteristics	Ref.
Langsat	Fruits are bunched together \approx 20 on one brown thick spike up to 20 cm length. Its fruit is oval or round \approx 2–3 cm long and has a yellowish skin, which when peeled release a latex, showing up a translucent white flesh that is divided into segments and has 1–3 seeds. On ripping, the flesh is fairly aromatic and juicy with a sweet-acidic taste.	[11]
Duku	Fruits are bunched together \approx 8–12, on one brown thick spike up to 20 cm length. Duku fruit is featured from langsat fruit by its larger size (3–5 cm in diameter), round shape, and much thicker skin that is comparatively free from latex. Also, it is generally more aromatic and sweeter than langsat.	[11]
Dokong (Longkong)	Fruits are occurred in bunches (25–30 fruits/bunch). Its fruit is globular with leathery, thick, and yellow skin, free of latex. The edible portion is juicy and fleshy is thin-skinned, nearly seedless, and free of latex, with uneven five-fragmented translucent white adhering aril. It has a nice aroma with a slightly sour and sweet taste.	[12] [13]
Duku-langsat	It is round, brownish-yellow, and intermediate in size. It has a sweet flesh and thinner skin than that of duku.	[5]
<i>L. domesticum</i> var. <i>typica</i>	Inflorescence: rachises, young branchlets, under the surface of leaves, and calyx sparsely pubescent or sub-glabrous. Fruit: oblong-obovoid or ellipsoid, pericarp thin with little milky juice, seeds small, aril thick and smooth.	[14]

Forms/Variety	Botanical Characteristics	Ref.
<i>L. domesticum</i> var. <i>pubescens</i> Koorders et Valetón	Inflorescence: young branchlets, rachises, calyx densely pubescent, under the surface of leaves. Fruit: sub-globose, pericarp thick with milky copious juice, thin and sour aril, large seeds.	[14]

The plant has different synonyms; *Aglaia domestica* (Correa) Pellegrin, *A. aquea* (Jack) Kosterm., *A. intricatoreticulata* Kosterm., *A. dookoo* Griff., *A. merrillii* Elmer, *A. steenisii* Kosterm., *A. sepalina* (Kosterm.) Kosterm., *Lachanodendron domesticum* Nees, *Lansium domesticum* var. *aqueum* Jack, *L. aqueum* (Jack) M.Roem., *L. domesticum* var. *typicum* Backer, *L. domesticum* var. *pubescens* Koord. & Valet., *L. javanicum* M. Roem., *L. javanicum* Koord. & Valet. ex Moll & Janss., *L. parasiticum* var. *aqueum* (Jack) Sahni & Bennet, *L. sepalinum* Kosterm., *L. parasiticum* Sahni & Bennet, *L. pedicellatum* Kosterm., and *Taeniochlaena polyneura* Schellenberg. Additionally, different local names have been given for *L. domesticum* [5][14][15][16] (Table 2).

Table 2. Different local names of *L. domesticum* according to the nationality [5][14][15][16].

Nationality	Name
English	Langsat, Duku
Burmese	Duku, Langsak
Filipino	Lanzone, Buahán, Lansones, Lanzón, Lansone
Indonesian	Langsat, Kokosan, Lanset Duku, Langsa, Lansot, Lasa, Lansat
Italian	Lansio, Lanzone
Malay	Langseh, Lansa, Langsep, Kokosan, Pijitan
Thai	Longkong, Duku, Langsat
Vietnamese	Bo'N-Bon
Chinese	Lan Sa, Lan Sa Guo
Japanese	Ransa
Spanish	Arbol De Lanza, Lanzón
Portuguese	Arbol-Do-Lanza
Surinam	Duki
Malaysia	Dokong, Duku Hutan, Duku, Duku-Langsat, Langsat-Hutan, Longkong, Langsat
Korean	Lang Sat
Danish	Langsat, Langsep
French	Lansium, Langsep
Dutch	Doekoe, Langsep
Costa Rica	Duki
Cuba	Duku, Kokosan
German	Doko, Echter-Lanzebaum, Duku, Lansabaum, Langsta, Lansibaum
Honduras	Duki
Taiwan	Lan sa guo
Kenya	lengeset
Sundanese	Kokosan, Pisitan
Javanese	Langsep, langsat, celoring
Madurese	Langsep

Its tree has a 40–50 ft height with long leaves which are dark green and pinnate with a glossy surface. The flowers are present in clusters on the old branches and trunk of the tree. They are mostly bisexual, small with a yellow-white color.

The fruits grow in clusters and are small, round (3–5 cm diameter) with a leathery yellow skin that can be thin or thick. The fruit's flesh is translucent and juicy with six or five segments which have seeds. The fruits may be sweet or acidic relying on the growing conditions and variety [5]. The delicious, succulent, fruit aril is eaten fresh directly after peeling or can also be candied or preserved in syrup [5][17][18]. The jams, juices, sherbet, and ice creams are the most popular langsat products. On the contrary, the seeds and peel are the main byproducts after the flesh's consumption, neither of which are widely used. However, the seeds and peels are a rich pool of bio-metabolites [12]. In Indonesia, the fruit is a very popular dessert, and the peel was traditionally known to be toxic to domestic animals [19]. The plant extracts exhibited various biological activities, including antimalarial, antifeedant, anti-aging, wound healing antioxidant, cytotoxic, analgesic, antibacterial, antimutagenic, insecticidal, and larvicidal. Phytochemical studies of *L. domesticum* indicated that triterpenoids particularly onoceranoids with unusual and unrivaled skeleton, cycloartenoid, and tetranortriterpenoid are the main constituents reported from this plant that displayed remarkable bioactivities.

In recent decades, herbal medicines have substantiated their publicity among consumers for both traditional and cultural reasons. Herbal medicines have been utilized for treating various ailments and diseases in many populations for thousands of years. They are considered the main treatment approach in many countries because of their safety, reliability, and affordability in comparison to synthetic ones that can cause adverse effects on human health. *L. domesticum* has immense role in providing medicinal and realistic value in many developing countries particularly in regions where medicine is unreachable, and the populations are in the need of healthcare.

2. Traditional Uses of *L. domesticum*

The different parts of *L. domesticum* have various medicinal and non-medicinal uses in many nationalities (Table 3). The peel is wealthy in non-toxic oleoresin that is utilized against diarrhea and fevers [8]. In Thailand, the peel and flesh have been used as facial toners, wash gels, and masks, as well as a skin moisturizer and whitening cream. Additionally, the seeds possess antifeedant and febrifugal capacities and pericarp is utilized for repelling mosquitoes [20][21]. *L. domesticum* bark was used by people in the Pakuli region of Palu for malaria treatment. Moreover, the boiled bark with water was utilized to reduce pain and fever [22].

Table 3. Non-medicinal and medicinal uses of *L. domesticum*.

Forms/Variety	Botanical Characteristics	Ref.
Fruit peels	In Java, it is dried and burned as incense in the sick people's rooms and to repel mosquitoes.	[23][24]
	It is utilized to cure diarrhea and intestinal parasites. Fruit peels are used as an arrow poison.	
Seeds	It is applied to the skin as a moisturizer and skin whitening cream.	[10][25]
	Borneo, it is utilized as talc powder by indigenous females of Dayak for skin protection from the sun.	
	Pulverized seeds mixed with water are utilized as a vermifuge for children. Also, they are utilized as a febrifuge.	
Bark	In Peninsular Malaysia, among the Sakai the bitter seeds were crushed and utilized for curing fevers.	[20][21][26]
	In the Philippines, pounded seeds mixed with water are used for deworming and ulcers.	
	A poultice of bark used against scorpion stings. A decoction is taken for malaria and dysentery treatment in Java, Borneo, and Malaya. A tincture is useful as an anti-colic or anti-diarrhetic.	
Resin	In Kenya, the bark is used for spleen and fever.	[8][17][24][27][28] [29]
	In Borneo, bark stew water decoction is taken by rural communities as an antifertility medicine.	
Leaf	It halts diarrhea and intestinal spasms.	[8]
	The resin from the bark is given for swellings, flatulence, and spasm.	
Peel and flesh	Its juice is utilized as eye drops to eliminate inflammation.	[24][30][31]
	A decoction of leaves and bark has been taken for curing dysentery. The Philippines used leaves for the control of mosquitoes. In Ibans in Sarawak, Malaysia leaves are used to treat fever.	
Wood tar	It is used as facial masks, wash gels, and toners.	[10][32]
	Peel is known to be toxic to domestic animals.	
Wood	It is used for blackening teeth.	[5]
	It is used for tool handles, house posts, and rafters	

Forms/Variety	Botanical Characteristics	Ref.
Bark and fruit	The fruit skin's juice and bark are utilized as a Dyak arrow poison.	[5]
Seed and bark	A decoction of seed and bark is used for the enlargement of spleen and fever in Kenya.	[28]
Stem	The decoction of the langsat stems and bark of <i>Pterocarpus indica</i> assists treating dysentery.	[33]

3. Nutritional Value of *L. domesticum*

The fruit tastes sweet and sour. It has a sour taste due to its low pH at about 3.85 that aligns with the reported total acidity of fruit $\approx 1.04\%$ [34]. Its taste has been resembled to a combination of grapefruit and grape and is considered excellent by most people. Its fructose, sucrose, and glucose contents are accountable for the sweet taste [35]. The fruit is a prosperous source of minerals, fats, protein, organic acids, carbohydrates, fiber, and vitamins. Various studies reported the evaluation of the nutritional value of this fruit. Chemical composition and mineral contents of flesh, peel, and seed of a fruit sample collected from Kuala Terengganu, Malaysia using ICP-OES (inductively couple plasma optical emission spectrometry) were previously evaluated [36]. The seeds had the highest crude protein (3.0 g/100 g), carbohydrates, and sodium, whereas the peels possessed high contents of crude fat, ash, calcium, potassium, and magnesium [36]. Furthermore, the seeds are rich in starch. Additionally, it was reported that the seeds and peels could have higher nutrient contents than pulp fruits [37]. In Thailand, the nutrient composition per 100 g langsat fruit had energy (66 cal), moisture (82.9%), protein (0.9 g), fat (0.1 g), fibre (0.3 g), carbohydrate (15.3 g), Ca (5 mg), Fe (0.7 mg), P (35 mg), vitamin A (15 I.U.), vitamin B2 (0.02 mg), vitamin B1 (0.08 mg), niacin (0.1 mg), and vitamin C (46 mg) [38]. In addition, it was found that 100 g edible portion of duku showed 34 kcal energy, 90 g water, 0.4 g protein, 0.0 g fat, 8.2 g carbohydrate, 0.9 g fiber, 0.5 g ash, 10 mg Ca, 20 mg P, 1.0 mg Fe, 12 mg Na, 230 mg K, 0.05 mg vitamin B1, 0.02 mg vitamin B2, 0.5 mg niacin, and 13.4 mg vitamin C [39]. Meanwhile, 100 g longkong fruit flesh contained protein 1.0 g and crude fat 0.5 g, which are higher than that of duku and langsat fruit [40]. Moreover, 100 g of longkong contains water 84 g, fiber 0.8 g, carbohydrates 14.2 g, Ca 19 mg, ash 0.6 g, K 275 mg, and vitamins (B2, B1, and C). The energy value is 238 kJ/100 g [41][42]. It is noteworthy that sodium, magnesium, potassium, zinc, calcium, iron, and manganese are the major minerals in the fruit [42][43].

4. *L. domesticum* Enzymes

Enzymes are important biocatalysts in food biotechnology. Plant-derived enzymes (e.g., bromelain, invertase, amylase, papain, ficin, lipoxxygenase, etc.) have played a remarkable role in various food industries, for example, dairy and bakery products, syrups, and alcoholic beverages. Besides, the plants can also be used as raw materials for enhancing the potential of the microbial enzyme that are employed in the food industry. *L. domesticum* fruit and pericarp are wealthy, with different active enzymes. On the other hand, these enzymes could contribute to the spoilage of the fruit. The fruits activated these enzymes for protection when they suffer from changes in the environment and/or storage temperature [42]. For example, oxidoreductases are activated when the peel or fruit is damaged. Phenylalanine ammonia-lyase, polyphenol oxidase, and peroxidase that are found in the pericarp oxidize the phenols to yield browning compounds [44][45]. Chitinase and β -1,3-glucanase are reported from the fruit peel that possessed antifungal potential towards *Metarhizium guizhouense* [46]. Polygalacturonase (PG) and pectin methylesterase (PME), as well as antioxidant enzymes: GPX (glutathione peroxidase), SOD (superoxide dismutase), and catalase (CAT) were detected in fully matured fruit that possessed high activities during fruit maturation [47]. Furthermore, the fruit had LOX (lipoxxygenase) that is accountable for the polyunsaturated fatty acids deoxygenation and converting them into fragrance and signaling molecules for regulating leukotriene [48]. It was reported that polygalacturonase, pectin methylesterase, and cellulases rise the sugar profile in the fruit and decrease the firmness of the fruit during ripening [47].

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