An Overview of the Antibacterial Implications of *Lansium domesticum*

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Abstract: *Lansium domesticum* belongs to the family Meliaceae and is admired for its fruit in southern Asia. The family Meliaceae is known as novel bioactive compounds that are usually used in folk remedy as a drug for the treatment of diarrhea. The leaf and bark mixture of *L. domesticum* cv. duku exhibited antibacterial activity towards *Bacillus subtile*, *Staphylococcus aureus*, and *Echerichia coli.* Phytochemical screening of fruit waste of *L. domesticum* showed the presence of 3β -hydroxyonocera-8, 21α -hydroxyonocera-8, 14-dien-21-one and 14-dien-3-one, lansic acid. The seeds contain tetranortriterpenoids. The bark contains active compounds namely onoceradienedione, lansiolic acid A, iso-onoceratriene and 3-keto lansiolic acid. The methanolic extract of the bark of L. *domesticum* cv kokossan showed major antibacterial efficacy against *Escherichia coli* and. *Bacillus subtilis* The ethyl acetate extract exhibited an antibacterial efficacy with an inhibit zone respectively of 14 and 12.5 mm towards *E. coli* and *B. cereus*. Silver nanoparticles have a future in an antimicrobial role. The silver nanoparticles of *L. domesticum* are spherical in shape with a size from10-30 nm.

Keywords: Meliaceae, *Lansium domesticum,* bioactive compounds, antibacterial efficacy.

INTRODUCTION

Natural products including animals, minerals and plants have been the basis of cure of human diseases. Scientists have made many observational and scientific efforts over the years for developing the current modern medicine system [1]. The Meliaceae is a tropical plant family. It contains 51 genera and 5,500 species. Extracts of the seed of many species have been reported to have toxic and effective insecticides. Triterpene of Meliaceae has a broad range of biological activities including as a growth regulator and as antifungal, bactericidal, and antiviral agents [2]. Indonesia is famous for its medicinal plants, which have been used routinely from generation to generation for treatment of diseases [3].

L. domesticum Corr is a tree found in Southeast Asia. The fruit of the plant is used as sweet dessert. The fruit waste is usually said to be poisonous to animals. Phytochemical screening of the peel showed the presence of lansic acid and glycosides. The volatile compounds of the fruit are sesquiterpene-containing germacrene-D. Tetranortriterpenoids (dukunolides) are present in the seed and leaf. The lansiolic acid is the main compound of the leaves and the cycloartanoid type carboxylic acid is present as minor triterpene [4]. The bark and leaf extracts of *L. domesticum* showed antibacterial activity towards *S. aureus*, *E. coli* and *B. subtiles*. Phytochemical tests on *L. domesticum* showed the presence of triterpenoid glycosides, tetranortriterpenoids, onocerandiendione-type triterpenoids and onoceranoid-type triterpenoids [5].

ORIGIN AND DISTRIBUTION

Langsat is native to Indonesia, Malaysia and Thailand. Production is mostly in Vietnam, Indonesia, Malaysia, Thailand and the Philippines. The plant particularly grows in a tropical climate. A humid atmosphere and a shady environment are required for its growth.

Botanic Description

Lansium domesticum is an erect, spreading, short-trunked tree that is 15 m in height, with yellow-brown, wrinkled bark. Its leaves are 22.5-50 cm long, with five to seven alternate elliptic-oblong leaflets. Both ends of the leaves are pointed, their upper surface slightly leathery and glossy pale with a prominent midrib. The flowers are small, pale-yellow or white, mostly bisexual, fleshy, branched or simple racemes that may be in hairy clusters or solitary, or on the trunk, straight and pendant shaped at the end, and 3 meters long. The fruits are in a cluster, with an oval shape, up to 5 cm in diameter, having a light pink, velvety skin, a milky latex and containing 5 or 6 segments of white juicy flesh (arils), that are translucent and aromatic. The seeds are somewhat fleshy and are present in 1-3 of the segments. The seeds are large, 2.5 cm long and 1.25-2 cm thick. The common names of the plant are given in Table **1** [6].

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Table 1: Common Names of *L. domesticum*

	Country	Name of the plant
1.	England	langsat
2.	Spain	lansón
3.	Philippines	lansones, boboa, buahan
4.	Indonesia	langsat, duku, kokosan
5.	Thailand	langsat, duku, longkong
6.	Vietnam	bòn-bon
7.	Malaysia	langsat, duku, duku-langsat

Nutrition Value of Langsat

The fruit is rich in vitamin B and phosphorus. This fruit also contains up to 14.3 g of carbohydrates and about 0.8 g of protein. Carbohydrate and alkaloid tests for *L. domesticum* gave the highest concentration. Lanzones only gave positive results to all tests associated to alkaloids [7]. The plant and fruit of *L. domesticum* is shown in Figure **1**.

Figure 1: A snapshot of *L. domesticum.*

Antibacterial Activity

The major antimicrobial compound is called Lansioside D and was isolated from the fruit peel of the plant. Different spectroscopic methods were used for its structure evaluation *e.g*., HR-FABMS analysis ID and 2D NMR experiments. Evaluation of *L .domesticum* for antimicrobial activity against a broad spectrum of microorganisms indicates that it has a significant efficacy against the *B. subtilis* and *S. aureus*, and to some extent towards *E. coli*. It shows no activity against molds and yeasts [8].

L. domesticum can be used as an antibacterial agent, due to its medicinal compounds. The fruit peel, seed and bark of the plant contain some bioactive compounds that can be used towards *Salmonella typhii*, *Vibrio cholerae*, *S. aureus and E. coli*. Many antibiotic tests were performed as a control. The active compounds were isolated through phytochemical tests [9].

Lamesticumin A., lamesticumin A., lamesticumins BF, lansic acid 3-ethyl ester, and ethyl lansiolate were separated from the twigs of the plant by spectroscopic analysis and their absolute configuration by using Snatzke's method. Moderate antibacterial efficacy was shown by the compounds towards gram positive bacteria [10].

L. domesticum Corr. is a moneymaking ripe fruit. Vegetative and non vegetative parts of *L. domesticum* are common sources for compounds with a wide spectrum of pharmacological activities *e.g.*, antibacterial, antitumor, antimelanogenesis, anticancer, antimalarial, and it may lead to the discovery of new active compounds used for antioxidative and antimutagenic stress [11].

Mohamed *et al.* reported [12] that the antibacterial activities of ripe and unripe leaves of guava, star fruit, banana, papaya passion fruit, two varieties of *L. domesticum* peel, and rambai peel were analyzed for antibacterial activity. Tube dilution assays and filter paper disc diffusion were used for testing antimicrobial efficacy. Extracts from ripe guava leaves, rambai peel and star fruit showed powerful antibacterial activity. Most of the fruit peel gave moderate activity against bacteria but poor activity towards fungi or yeast. Extracts from papaya, rambutan peel, *L. domesticum* peel, passion fruit peel, and bananas showed activity towards *candida lypolytica*, while guava extracts showed powerful activity toward *accharomyces cerevisiae*.

L. domesticum Corr., which is commonly found in South-East Asia, includes many varieties. Antimicrobial efficacy and phytochemical screening of three varieties of *L. domesticum*, Langsat, Dokong and Duku, were tested. The methanolic, hexane and water extracts of seeds from the matured fruits were used for testing antimicrobial activities against *S. aureus, B. subtilis*, and *Pseudomonas aeruginosa.* It was reported that Langsat seed extracts, composed of extra groups of active compounds compared to the Dokong and Duku and methanol extract, gave the highest inhibition zones towards the three bacteria. The crude methanolic extract of the seeds of Duku gave inhibition zones only

Table 2: Antibacterial Efficacy of Active Compounds against different Bacteria

	Names of compounds	The Antibacterial Efficacy of Compounds
1.	3β-hydroxyonocera-8(26),14-dien-21-one	Moderate activities towards *P.aeruginosa*
2.	α,γ-onoceradienedione	High activity towards *P. aeruginosa*.
3.	Lansiolic acid	Moderate activity against *P. aeruginosa* and low efficacy against *S. aureus*.
4.	Lansionic acid	Moderate efficacy towards *P. aeruginosa* and low activity towards *B. subtilis*
5.	Lansioside C	Low efficacy against *B. subtilis*, low efficacy against *S. aureus.*

towards *B. subtilis* at a high range and the extracts of Dokong gave no inhibition zones towards the tested bacteria [13].

Lansioside D is isolated from the peel of *L. domesticum*. This compound has antimicrobial activity. It also shows antibacterial activity against Methicillin-resistant *S. aureus*. In the initial phase it was studied as a potential drug and its acute oral toxicity was investigated on mice.. No toxicity was found in mice so it was confirmed that Lansioside D is not toxic, therefore a possible source of new antibodies [14].

Five onoceroidtriterpenes were isolated from the fruit waste of *L. domesticum* Corr. lansiolic acid and germacrene D. present in seeds. The antimicrobial tests gave the results as described in Table **2** [15].

A new triterpenoid was isolated from the leaf part of *L .domesticum*. The compounds were 19-cyclolanost-24-en-3-one, 21, 23-epoxy-21, 22-dihydroxy (21R, 22S, and 23S). Spectroscopic data, comparison with related compounds, and X-ray diffraction were used for the identification of its structure [16].

Green synthesis of AgNPs using plants is now popular.. The sizes of AgNPs are up to 100 nm. AgNPs have great prospects to act as antimicrobial agents. AgNPs of *Lansium domesticum* are spherical in shape and a size of 10 -30 nm [17].

CONCLUSION

Phytopharmacology of different extracts and characterization of active phytopharmaceuticals have been investigated by different researchers. However, clarification of methods for isolation of compounds and clinical tests of the bioactive compounds are still needed. The new triterpenoid isolated from the methanolic fruit extract seems to be the major antimicrobial that is similar to lansioside C and is called lansioside D. It is concluded from the reports that Lansioside D can be safe up to doses of 1000 mg/kg body weight. This could be a scientific basis for future development of Lansioside D as a prospective new antibiotic.

Based on IR, UV, C13-NMR, 2D-NMR and H1-NMR spectroscopic data and comparison with reported data, the presence of the compound 14-hydroxy-7-onoceradienedione that is also responsible for antibacterial activity and obtained from the bark extract of *L. domesticum* was indicated. Therefore AgNPs of *L. domesticum* might also be used as a significant alternative antimicrobial agent.

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