World Journal of Biology Pharmacy and Health Sciences
eISSN: 2582-5542
Cross Ref DOI: 10.30574/wjbphs
Journal homepage: https://wjbphs.com/

(REVIEW ARTICLE)

Mimusops elengi L. (Botany, Utilization and Bioactivity)

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World Journal of Biology Pharmacy and Health Sciences, 2025, 22(03), 001–008

Publication history: Received on 07 March 2025; revised on 30 May 2025; accepted on 02 June 2025

Article DOI: https://doi.org/10.30574/wjbphs.2025.22.3.0411

Abstract

Mimusops Elengi is a plant with multiple functions, namely as an ornamental plant with a fragrant flower aroma and ripe fruit can be used as food ingredients. This study aims to explain the botany, utilization, bioactivity and secondary metabolites of *M. elengi*. The research method is through a research library of online sources on Google Scholar using the keywords *M. elengi* and uses of *M. elengi*. Data analysis was carried out qualitatively. *M. elengi* has a tree habitus, scattered leaves, white petals and flower crowns and a fragrant aroma. The all parts of *M. elengi* plant, including the stem, bark, leaves, fruit, roots, and seeds have medicinal properties. In traditional medicine *M. elengi* is used for wound healing, overcoming pain, inflammation, brain tonic, calming anxiety. *M. elengi* bioactivity as an antimicrobial, anti-cancer/tumor, antioxidant, anti-inflammatory, anti-anxiety, antifertility, and anti-diabetes mellitus. The use of *M. elengi* as an anticancer has great potential to be developed, so further research is needed. The content of flavonoids and tannins, such as quercetin and catechins are related to antioxidant and anticancer activities.

Keywords: *Mimusops elengi*; Anti-cancer; Flavonoids; Bioactivity

1. Introduction

Plants are a source of phytochemicals that are often used in drug development to treat various diseases [1]. Until now, most of the world's population, especially in developing countries, still relies on traditional medicine systems by utilizing various medicinal plants. This is related to the fact that the use of plants and natural products is considered cheaper, easier to obtain, has a higher level of safety, and has low side effects [2]. *Mimusops elengi* is one of the indigenous plants of Asia including Indonesia which is used in various traditional medicines [3,4].

Mimusops elengi is a plant with multiple functions, namely as an ornamental plant with fragrant flowers [5,6] and ripe fruit can be used as food [4]. Empirically, especially in Indonesia, *M. elengi* is widely used as a shade plant so that it is easy to find in various city parks and roadsides because of its beautiful canopy and fragrant flowers [7]. The use of *M. elengi* as a traditional medicine is more prominent than other uses. In traditional medicine in India, *M. elengi* is used for wound healing, pain relief, and inflammation [8,9,10,11]. In traditional Indian and Thai medicine systems, *M. elengi* flowers are used as a brain tonic and to calm anxiety and panic attacks [12].

The all parts of *M. elengi*, such as stems, bark, leaves, fruit, roots, and seeds has medicinal properties [4,13,14]. The extracts of the bark, fruit, leaves, seeds, and flowers have activity to cure cardio tonic, alexipharmic, hypertension, antibacterial, anthelmintic, anti-gastric ulcer, and tooth cleanser [1]. The flower is also reported to be a brain tonic, expectorant, and has been used for the treatment of asthma [11]. The bark, fruit, and seeds of *M. elengi* have several medicinal properties such as astringent, tonic, and febrifuge [15].

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Pharmacognostic studies of medicinal plants role to identification, purity, and quality of medicinal raw materials [15]. The use of plants as traditional medicine is related to their bioactivity and secondary metabolite content. This study aims to explain the botany, benefits, bioactivity and secondary metabolite content of *M. elengi*.

2. Methodology

This article is based on a literature study of various research results published online on Google Scholar using the keywords *M. elengi* and uses of *M. elengi*. Data analysis was carried out qualitatively. The information obtained was synthesized to obtain comprehensive information regarding the botany, bioactivity and secondary metabolites of *M. elengi*.

3. Results and Discussions

3.1.1. Botany of Mimusops Elengi L.

Sapotaceae is grouped into 5 tribes with 53 genera and around 1250 species [16]. Sapotaceae Juss. (1789) is a family characterized by a well-developed latex system, unicellular trichomes, two arms, leaves below are often copper-colored, axillary inflorescences, ramiflorous or cauliflorous, simple or complex flower structure, oppositipetalous stamens; and sometimes with staminodes [17]. *Mimusops elengi* is one type that is widely used as a traditional medicine.

Description: A medium-sized tree, 13 m in tall (Figure 1A). Bark with a slightly rough surface. Leaves are single and supported by a support that falls off quickly. Leaf arrangement is spreading (Figure 1B). Leaf stalk length 1 - 2.7 cm. Leaf blade elliptical or slightly rounded ovate, 3.5 - 14 cm long and 2 - 6 cm wide. The base tends to be asymmetrical and the tip is usually pointed, and less often pointed or blunt. Flowers emerge from leafy twigs in an arrangement either solitary or in clusters (Figure 1C). Flowers are fragrant. Flower stalks are 7 - 20 mm long. Petals with 8 segments and are arranged in two rows. Petals are 6.5 - 8 mm long and the outer row is wider than the inner row. The corolla is partially fused to form a tube with 8 segments and is creamy white in color. The length of the segment is between 6.5 - 8 mm and each segment is divided into 3. The stamens are 8 in number and alternate with sterile stamens which also number 8 (Figure 1D-F). The ovary is overlapping and covered with hairs and a stalk of 4 - 7 mm long. Fruit and Seeds: The fruit is a berry type, round or oval, with a diameter of 12 - 14 mm or rarely up to 22. The seeds are 11 - 14 mm long and 7 - 9.5 mm wide with a flattened oblong shape [18,19].

Figure 1. *Mimusops elengi*. A. Habitus; B. Branches supporting leaves and fruits; C. Branches supporting leaves, flower buds and flowers; D. Flower buds and blooming flowers; E. Flowers with white crowns and other parts. E. Flowers that have fallen to the ground

3.2. Uses and Bioactivity

Mimusops Elengi has long been used as a traditional medicine. Various treatment systems such as Ayurveda [6]. All parts of the plant such as leaves, roots, fruits, seeds, bark, flowers of *M. elengi* are used as traditional ingredients [4]. In various traditional treatment systems, *M. elengi* is used as an astringent, tonic, and fever reducer [6]. The skin and fruit of this plant are used in the treatment of diarrhea and dysentery, and a decoction of the skin is used as a mouthwash [2]. The use of *M. elengi* as a traditional medicine is related to its bioactivity. The following will explain in more detail the bioactivity of *M. elengi* as an antimicrobial, anti-cancer/tumor, antioxidant, anti-inflammatory, anti-anxiety, anti-fertility, and anti-diabetes mellitus.

3.3. Anti-Microbial

Various pathogenic microbes cause various infections in humans. The search for natural products as anti-microbials continues to be carried out as an alternative to overcome resistance to antibiotics. Various researchers have revealed that plants as anti-microbials are also related to anti-inflammation [20,21]. Almost all parts of *M. elengi* have anti-microbial and anti-inflammatory activities ranging from leaves, bark [21,22], flowers [20], seeds [22,23]. Flower oils

show antibacterial activity against bacteria and anti-inflammatory [20,21]. The *M. elengi* inhibits the growth of Gram-negative bacteria [20,21] and Gram-positive [5,24]. The leaf and bark extracts of *M. elengi* inhibit the growth of *Staphylococcus aureus* [5,13,21,23,24], *Escherichia coli* [5,13,22,23], *Pseudomonas aeruginosa* [13,22,23], *Staphylococcus epidermidis* [5,13], *Bacillus subtilis* [5,23], B*. cereus, Micrococcus luteus* [24], *Proteus vulgaris* [5,22,13], *Streptococcus pneumoniae* [13], *Enterococcus durans, Listeria innocua, Klebsiella pneumoniae, Salmonella enteritidis, Salmonella kentucky, Xanthomonas* [5], and *Klebsiella pneumoniae* [22].

Antimicrobial bioactivity is influenced by solvent compounds, dosage, and organs used [13,23]. The hexane extract seed of *M. elengi*, showed high inhibition zone followed by ethyl acetate and methanol [23]. The methanol extracts of *M. elengi* leaf showed high inhibition zone followed by ethanol, chloroform, and petroleum ether [13]. The concentration-dependent activity of the extract against bacteria was recorded with a zone of inhibition diameter of 7-21 mm. The extract combined with antibiotics (cefpodoxime, gentamicin, and ciprofloxacin) had a growth inhibition index (GII) of 0.5-0.6, 0.5-0.89, and 0.73-0.82 against clinical isolates of *E. coli, K. pneumoniae,* and *Proteus vulgaris*, respectively, whereas for standard strains (*E. coli, K. pneumoniae*, and *P. aeruginosa*), the had growth inhibitory indices ranged 0.56-0.86 [22]. The leaf, seed, and bark extracts of *M. elengi*, combined with antibiotics, had synergistic interactions against all standard bacterial strains and clinical isolates of *P. vulgaris*, while synergistic and additive interactions were recorded against clinical isolates of *E. coli* and *K. Pneumoniae* [22].

3.4. Anti-Cancer and Anti-Tumors

Cancer is one of the main causes of human death caused by excessive or uncontrolled cell division. Exploration of natural materials that have the potential as anti-cancer continues to be carried out including *M. elengi*. Plants that have the potential as anti-cancer produce compounds that can inhibit cell growth or are cytotoxic [25]. The potential of *M. elengi* as an anti-cancer can be seen from its ability as an antiproliferative, stimulating apoptosis and bcl2 gene expression [26].

Almost all parts of *M. elengi* have the potential as anticancer because they have cytotoxic activity such as flowers, leaves, bark [10]. *Mimusops Elengi* extract showed significant antiproliferative effects on Ehrlich ascites carcinoma (EAC) cell lines [26]. The extract of *M. elengi* is useful for preventing and treating cervical cancer [27], breast and colon cancer [5]. The extract of *M. elengi* leaf showed high cytotoxic activity against six cancer cell lines: TK6, HeLa, HepG2, HT-29, MCF-7 and KB with CC50 values (cytotoxic concentration 50%) of 179.38, 379.06, 442.61, 500.66, 517.98 and 541.06 µg/ml respectively [25].

The bioactivity of *M. elengi* as an anticancer agent varies depending on the dose and compounds used in the extraction [26]. The bark and leaf extracts *of M. elengi* were effective against the tested cell lines, with IC50 values of 35.08 ± 2.92 µg/ml and 67.46 ± 4.21 µg/ml, respectively [27]. The increase in apoptotic bodies from 0.24% to 60% and 69% after treatment with the extract [27]. The dichloromethane and ethyl acetate fractions of *M. elengi* have specific cell cycle inhibitory activity in the G0/G1 phase. In the Ehrlich ascites carcinoma (EAC) model, the ethyl acetate fraction together with the standard (cisplatin) effectively reduced weight gain compared to the control and increased the mean survival time [10].

Anticancer potential can be tested through DNA fragmentation test [26] and MTT test (3-(4,5-dimethylthiazol-2-yl)-2; 5-diphenyltetrazolium bromide) [27]. Administration of ME extract, in cell cycle analysis and Annexin V-FITC test, resulted in arrest in the sub-G1 phase and initiation of cell apoptosis and in western blotting studies showed low expression of bcl-2 and excessive expression of Bax protein [26]. Cytotoxic and antioxidant bioactivity are thought to be related to phenolic content [25]. Flowers are rich in flavonoids and tannins, such as quercetin and catechin, which are known for their antioxidant and anticancer activities [28].

3.5. Antioxidant

Antioxidant compounds are compounds that can inhibit free radicals. Free radicals are directly or indirectly related to various diseases such as diabetes mellitus and cancer. The bioactivity of *M. elengi* as an antioxidant is more prominent compared to other bioactivities. This is related to the fact that various diseases are directly or indirectly related to free radicals. The antioxidant capacity of *M. elengi* is equivalent to ascorbic acid and butylated hydroxyl anisole (standard) [29].

The bioactivity of *M. elengi* as an antioxidant is influenced by various factors such as dose, solvent polarity and organs used [25,26]. The free radical scavenging properties in the laboratory can be tested with peroxynitrite, superoxide and hypochlorous acid models [26]. In the in vitro antioxidant method, methanol extract of leaves showed higher free radical scavenging activity compared to the standard with IC50 of 10.25 µg/ml (2,2-diphenyl-1-picrylhydrazyl/DPPH) and 13.5

µg/ml (2,2′-azinobis (3-ethylbenzothiazoline-6-sulfonic acid/ ABTS) [22]. Methanol extract of leaves showed higher antioxidant activity than flower petals with IC50 values in DPPH and ABTS radical scavenging tests of 98.20 and 236.13 µg/ml, respectively [25]. The inhibitory concentration of DPPH by leaf extract was higher in methanol (inhibitory concentration 50 = 8.74) followed by ethanol> 80% ethanol> 80% methanol> acetone> water> chloroform> ethyl acetate [30]. Tanjong leaf extract showed antioxidant activity of 3.2 µg ascorbic acid/g fresh weight and IC50 of 23.35 µg/ml [24].

Antioxidant bioactivity is directly related to the content of phenolic compounds [22,30]. Phenolic compounds in *M. elengi* are rich in flavonoids, tannins, phenols, terpenoids, and saponins [31]. The total phenolic content of methanol extracts from petals and leaves using the Folin-Ciocalteu method showed 49.32±3.04 and 93.36±3.58 mgGAE/g extract, respectively [25]. TPC was higher in methanol (6.2±0.01 mg gallic acid equivalents/g) followed by ethanol> 80% methanol> acetone> water> ethyl acetate> 80% ethanol> chloroform [29]. Dichloromethane leaf extract showed significant antioxidant activity when compared to standard butylated hydroxyl anisole/BHA [29].

3.6. Anti-Inflammatory

The anti-inflammatory compounds are substances that function to reduce inflammation or pain or dysfunction related to inflammation. The *M. elengi* has been used for rheumatism [31] and pain associated with anti-inflammatory activity [22,31,32]. Almost all parts of ME have anti-inflammatory activity starting from the leaves [22,31], flowers [31] and bark [32]. Phenolic compounds, flavonoids [22] and terpenoids [32] may play an anti-inflammatory role in M. elengi. The leaves contain significant concentrations of alkaloids, particularly elengioside, which has shown potential anti-inflammatory and analgesic properties [28]. The bark of *M. elengi* shows the presence of terpenoids, including lupeol and betulinic acid, which are associated with anti-inflammatory properties [28]

The methanol extract of *M. elengi leaves* has anti-inflammatory activity in vivo (inhibition of carrageenan-induced paw edema in rats) [22,32]. Anti-inflammatory activity of *M. elengi* methanol extract against carrageenan-induced paw edema in albino rats at doses (50, 100, 200 mg/kg) has a significant effect on inflammation and significantly reduces swelling [31]. Pretreatment with ethanol extract of *M. elengi* bark given orally at 200, 400 mg/kg (p.o) showed significant anti-inflammatory activity in acute and chronic models [32].

3.7. Anti-Anxiety

In traditional Indian and Thai medicine systems, *M. elengi* Linn. flowers are used as a brain tonic and to calm anxiety and panic attacks [12]. The hydroalcoholic extract of *M. elengi* has neuroprotective effects against cerebral ischemic reperfusion injury in rats. Pretreatment with *M. elengi* at doses of 100 and 200 mg/kg significantly improved neurobehavioral changes and reduced infarct volume, edema, and degree of blood brain barrier disruption caused by ischemia reperfusion injury. These results clearly demonstrate the neuroprotective effects of *M. elengi* against injuries such as stroke [12].

3.8. Anti Diabetes-Mellitus

Mimusops Elengi has α-amylase inhibitory activity. The highest flavonoid content (1059.80 ± 2.15 mg CE/g) and total antioxidant capacity (0.17 ± 0.005) were found in the chloroform fraction. On the other hand, the ethyl acetate fraction showed the highest total phenolic content (182.90 ± 0.38 mg GAE/g). The crude methanol extract showed the highest α-amylase inhibition with an IC50 value of 4.09 ± 0.08 mg/ml [33].

3.9. Anti Fertility

Oral administration of aqueous fruit extract of *M. elengi* (200, 400 and 600 mg kg−1 body weight/day for 35 days) to male rats showed non-uniform and variable degenerative changes in the seminiferous tubules; affected and normal tubules were observed in the same testis section. The treatment had adverse effects on testicular hydroxysteroid dehydrogenase, serum testosterone levels and on motility, viability and number of spermatozoa in the cauda epididymis. In addition, libido was not affected in treated males, but their fertility was markedly suppressed. The *M. elengi* treatment caused reversible suppression of spermatogenesis and fertility in Parkes rats [34].

4. Secondary Metabolites

Secondary metabolites are compounds produced by plants from secondary metabolism processes. Various secondary metabolites of plants have long been used as traditional medicine ingredients and as raw materials in the

pharmaceutical industry. The types of secondary metabolites produced by plants vary between species and also vary between different organs.

The following are secondary metabolite contents found in various *M. elengi* organs: the roots contain alkaloids, flavonoids, saponins, sterols, and tannins [35]; the bark contains terpenoids, including lupeol, betulinic acid [15,28], taraxerol, and spinasterol β-Dglucopyranoside [21]; the leaves contain alkaloids, especially elengioside [28], spinasterol, ursolic acid, and 3β, 6β, 19α, 23-tetrahydroxyurs-12-en-28-oic acid [21], phenolics [36,37], flavonoids, coumarins, and stilbenes [37]. The main flavonoids include myricitrin, myricetin, and kaempferol-3-O-alpha-L-rhamnoside. Coumarins and phenolic acids include aesculin and quinic acid [37]. The flowers contain flavonoids, tannins, quercetin, catechins [28], essential oils [15], phenolics [11,37], terpenoids [11]. The most abundant volatile components are 2-phenylethanol, (E)-2-hexenal and benzyl alcohol [20]; Seeds contain fatty oils [15].

5. Conclusion

- The *M. elengi* has a tree habitus, scattered leaves, white petals and flower crowns and a fragrant aroma.
- In traditional medicine *M. elengi* is used for wound healing, overcoming pain, inflammation, brain tonic, calming anxiety.
- Bioactivity of *M. elengi* as antimicrobial, anti-cancer/tumor, antioxidant, anti-inflammatory, anti-anxiety, antifertility, and anti-diabetes mellitus.
- Flavonoid and tannin of *M. elengi* esspecially quercetin and catechin are related to antioxidant and anticancer activities.

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