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Botany, Traditional Uses, Phytochemistry and Pharmacology of *Archidendron jiringa*: A Review

[1]*Hamidun Bunawan,* [2]*Lukas Dusik,*
[1]*Siti Noraini Bunawan and* [1]*Noriha Mat Amin*

[1]Biotechnology Research Centre, Malaysian Agricultural Research and Development Institute,
P.O Box 12301, General Post Office, 50774 Kuala Lumpur, Malaysia
[2]Private College of Economic Studies in Znojmo, Loucka 656/21, 669 02 Znojmo, Czech Republic

Abstract: *Archidendron jiringa* (Jack) Nielsen is a leguminous tree plant belonging to the family of Fabaceae. *A. jiringa* has been commonly used in traditional medicine for a range of ailments and is consumed as raw vegetable in Malaysia. In order to provide comprehensive overview of this plant, this review will summarize the current state of knowledge that is available on the botany, phytochemistry, pharmacology and toxicology of *A. jiringa*. Moreover, this review will provide a basis platform for future research and commercial exploitations of the plant.

Key words: *Archidendron Jiringa* · Botany · Phytochemistry · Pharmacology · Toxicology

INTRODUCTION

The use of traditional medicines including herbal medicines has been recently growing in countries worldwide including Malaysia [1-4]. Herbal medicines are very often used for medical purposes and self-prescribed to relieve minor illnesses such as fevers, colds, diarrhoea, coughs, headaches and stomach-aches [5-7]. These medicines are also used to maintain physical fitness and as health supplements [7-10].

Archidendron jiringa (Jack) Nielsen, commonly recognised as Dogfruit, Jering (Malaysia), Jengkol (Indonesia) or Luk Nieng (Thailand) is native to Southeast Asia [11]. People in this region consume parts of this plant because of its therapeutic value which includes blood purification or overcoming dysentery [12], even though several studies reported that *A. jiringa* can cause djenkolism [13]. *A. jiringa* beans are usually consumed raw, roasted or fried and are available on market most of the year. Djenkolism is known by health practitioners to cause symptoms such as severe vomiting, intense colic, diarrhoea or constipation, dysuria, macroscopic haematuria and oliguria that may result in anuria.

This present review intends to provide details of traditional knowledge and to highlight some of published scientific reports on *Archichendron jiringa* (Jack) Nielsen with focus on botanical, phytochemical, pharmacological and toxicological aspects.

Botany

Botanical Names

***Archidendron jiringa* (Jack) Nielsen**

Synonyms: *Abarema jiringa* Kosterm, *Albizzia jiringa* (Jack) Kurz, *Albizia lucida* sensu auct., *Archidendron pauciflorum* (Benth.) I.C. Nielsen, *Feuilleea jiringa* Kuntze, *Inga bigemina* sensu auct., *Inga jiringa* (Jack) D.C., *Inga kaeringa* (Roxb.) Voigt, *Inga lobata* Grah., *Mimosa jiringa* Jack, *Mimosa kaeringa* Roxb., *Pithecellobium bigeminum* sensu auct., *Pithecellobium jiringa* (Jack.) Mansf., *Pithecellobium jiringa* (Jack) Prain, *Pithecellobium lobatum* Benth., *Zygia jiringa* (Jack) Kosterm [11].

Botanical Description and Distribution: The tree is about 18-25 meters tall, multi-branched with a spreading crown (Figure 1). Its leaves are bi-pinnate up to 25 cm long and have a grey glabrous bark. Fruit of this tree is falcate,

Corresponding Author: Siti Noraini Bunawan, Biotechnology Research Centre,
Malaysian Agricultural Research and Development Institute, P.O Box 12301,
General Post Office, 50774 Kuala Lumpur, Malaysia.

Fig. 1: *Archidendron jiringa* (Jack) Nielsen

twisted, deep purple 20-25 cm by 4-5 cm wide and easily broken by hand. It grows in large, dark purple pods which contain usually 3 to 9 beans [11]. Crushed fruit produces a faint sulphurous odour. This species is native to tropic countries of Southeast Asia; such as Malaysia, Bangladesh, Myanmar, South Thailand and parts of Indonesia [11].

Ethnobotanical Uses: The *A. jiringa* is economically important due to wide variety of uses. Young shoots of this plant are commonly consumed as a vegetable, the seeds are usually used as pulse or food flavouring agent. Leaves and seeds of *A. jiringa* are important for their medicinal significance. Furthermore, the pods of this tree are found as a good source of dye for silk and also timber for craft work and firewood.

In ethnomedicine uses, pounded leaves and bark of *A. jiringa* are used to treat toothache, gum pains, chest pains and skin ailments in the old Malaysian folk. In order to treat wounds and cuts, ashes of burnt young leaves are applied onto the injured area. Raw eaten seeds cotyledons are believed to help to purify the blood and to serve as anti-diabetic agent, moreover seeds' juice is traditionally used to induce urination [12, 14].

Phytochemistry: Many previous studies highlighted the sulphur-containing amino acid, namely djenkolic acid has been found in *A. jiringa* bean (Figure 2). The compound was first isolated by Van Veen and Hyman [15] from urine of Javanese who consumed *A. jiringa* beans and suffered

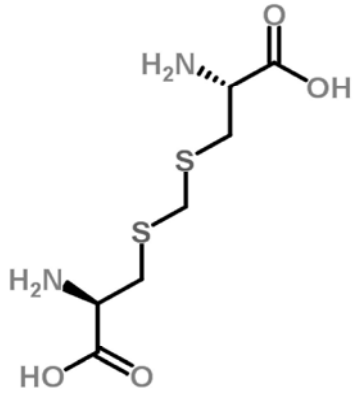

Fig 2: Chemical structure of djenkolic acid.

from djenkolism poisoning. Later, djenkolic acid was able to be synthesized by du Vigneaud and Patterson [16]. Min-Won *et al.* [17] characterized the metabolite profiling of *A. jiringa* leaves and reported five flavan-3-ol derivatives which include new flavan-3-ol gallates, gallocatechin 3'- and 4'-O-gallates as well as gallocatechin 7,3'- and 7,4'-di-O-gallates that occur as equilibrium mixtures. On the other hand, pods examination of *A. jiringa* afforded three proanthocyanidins known as procyanidinds B-3 and B-4 and prodelphinidin B-1, as well as flavan-3-ols. Additionally, a study carried out by Norulaini *et al.* [14] on the volatile oil of *A. jiringa* seeds using supercritical carbon dioxide with fast gas chromatography time of flight mass spectrometry revealed 55 metabolites. The metabolites identified were generally found to be fatty acids, terpenoids, ally sulphur, vitamin E and alkaloid.

Pharmacological Reports

Antimicrobial: Bakar *et al.* [18] reported antimicrobial activity of methanol extract from leaves, pods and seeds of *A. jiringa*. Disc diffusion assay was used to evaluate the sensitivity of the samples and liquid dilution method was used for observation of its minimal inhibition concentration (MIC). The study showed that all *A. jiringa*'s extracts have antibacterial and antifungal activities against the tested organisms. The minimal inhibition concentration showed that the leaf extract of *A. jiringa* was mostly active for *Staphylococcus aureus*, *Staphylococcus epidermidis* and *Microsporum gypsum* (100 mg/ml).

Previously, Charungchitrak *et al.* [19] reported the antibacterial and antifungal activities of lectin from *A. jiringa* seeds. It was found that the lectin does possess hemagglutination activity against human blood group, mouse, rat, rabbit, guinea pig, sheep and geese erythrocytes. Interestingly, *A. jiringa* lectin was observed to have antifungal activity even at low concentrations against *Exserohilum turcicum*, *Fusarium oxysporum* and *Colletotrichum cassiicola*.

Antioxidant: The shoots of *A. jiringa* have been found to have high polyphenolic contents (>150ug gallic acid equivalents/mg dried plant) and antioxidant activities when measured using ferric reducing antioxidant power (FRAP) [20]. Preliminary analysis of ethanolic and 50% hydro-ethanolic extracts of *A. jiringa* revealed the presence of phenolics, flavonoids, terpenoids and alkaloids in both extracts [21]. Both of them were also reported to have high potent DPPH (1,1-diphenyl-2-picryl-hydrazyl) scavenging activity, which 50% hydro-ethanolic extract was more effective with IC_{50} 18.48 ± 1.60 µg/ml compared to ethanol extract showed an IC_{50} of 33.52 ± 2.05 µg/ml.

Anticancer: *In-vitro* anti-tumor activity was reported from *A. jiringa* beans. Inhibition test of Epstein-Barr virus (EBV) in Raji cells was used for this purpose and the cells were induced by 12-O-hexadecanoylphorbol-13-acetate [22]. The methanolic extract of *A. jiringa* at concentration of 200mg/mL was considered to inhibit the EBV activation by 30% or more.

Antigastric: An experiment on evaluation of gastroprotective mechanisms of *A. jiringa* ethanol extract against ethanol-induced gastric mucosal ulcers in Sprague-Dawley rats was studied by Ibrahim *et al.* [23]. These rats were divided into five groups and absolute ethanol was administered orally to cause gastric mucosal injury. The study reported that pre-treatment with the extract of *A. jiringa* significantly reduced the development of ethanol-induced gastric lesions and gastric wall mucus was well-preserved. Additionally, the results also showed a significant increase in superoxide dismutase (SOD), the enzyme that is important in protecting gastrointestinal mucosa.

Antinematodal: Mackeen *et al.* [24] reported antinematodal activity of *A. jiringa* against *Bursaphelenchus xylophilus*, a nematode that infects the pine tree with use of fungal-feeding assay. The extract of *A. jiringa* showed moderate activity with minimum effective dose (MED) in between 5 and 10 mg per ball.

Antidiabetic: Administration of dietary *A. jiringa* to diabetic rats considerably reduced blood sugar in streptozotocin-induced diabetic rats after 12 weeks of consumption [25]. After 15 weeks of treatment, *A. jiringa* improved appetite, weight, organ oxidative status and also a number of active islets of Langerhans for both normal and diabetic rats. Despite showing beneficial effects to diabetic rats' eye lens, pancreas and lungs, *A. jiringa* extract caused hypertrophy and lesions to liver, kidneys, heart, lungs and pancreas of normal rats.

Toxicology: Several studies in the past reported djenkolism caused by *A. jiringa* [13, 26, 27]. As *A. jiringa* contains nitrogen compounds, djenkolism is often associated with high level of these compounds leading to azotemia and is capable of causing spasmodic pain, urinary obstruction and acute renal failure.

A recent djenkolism case study by Jin *et al.* [13] reported effects of the beans consumption on a 45-year-old patient following ingestion of *A. jiringa*. The study highlighted djenkolism as a cause of acute anuric renal failure where the patients had symptoms of poisoning within 48 hours after the seeds intake. Presence of needle-like crystals in urine led to thick urine sludge formation in patients' bodies. The therapies of djenkolism include rest and administrating intravenous to alkalinisation of the urine with sodium bicarbonate to change the urine pH from acidic to alkaline [28].

A. jiringa also was reported to have very strong toxicity (LC_{50}: <100 ppm) after being tested for brine shrimp lethality [29]. In contrast, recent acute toxicity tests on Sprague-Dawley rats, *A. jiringa* ethanol extract did not demonstrate any signs of toxicity and mortality up to 5 g/kg [23].

CONCLUDING

Modern pharmacological studies have demonstrated that *A. jiringa* has antimicrobial, antioxidant, anti-gastric, antinematodal and antidiabetic effects. The detailed information in this review showed that *A. jiringa* has a high potential to be exploited for drug development. Despite its pharmacological importance, nitrogen compounds found in *A. jiringa* could cause djenkolism. Extensive research is needed to validate the details of mechanism of action of djenkolic acid, the compound that causes djenkolism in previous case reported.

Based on this review, it is concluded that there is not sufficient information on the phytochemistry of *A. jiringa* and the chemical responsible for each bioassay does not seem to have been determined. Further study on the relationship of the biological activities and pure bioactive compound could be beneficial to understand cell signaling pathways as well as biochemical network for this plant.

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