Review Article

DOI : https://doi.org/10.7454/psr.v12i1.1391

Pharmaceutical Sciences and Research (PSR), 12(1), 2025, 12-32

Potential of Legume Seeds from the Leguminosae Family as Material Source of Food and Medicine : A Literature Review

Ni Made Ayu Gangga Dewi[1], Nina Dewi Oktaviyanti[2,3], Aurapa Sakulpanich[4], Kartini Kartini[2,3*]
[1]Master of Pharmacy Study Programme, University of Surabaya, Surabaya, East Java, Indonesia
[2]Department of Pharmaceutical Biology, Faculty of Pharmacy, University of Surabaya, Surabaya, East Java, Indonesia
[3]Center of Excellence for Food Products and Health Supplements for Degenerative Conditions, University of Surabaya, Surabaya, East Java, Indonesia
[4]Division of Pharmaceutical Sciences, Faculty of Pharmacy, Thammasat University, Thailand

ABSTRACT

Leguminosae, also known as Fabaceae, is the third largest plant family after Orchidaceae and Asteraceae. This review aimed to explore the potential of several legume species indigenous to Indonesia, from the Leguminosae family, as sources of food and medicine. The data used for the analysis were collected from various online databases such as PubMed, ScienceDirect, and Google Scholar. The results showed that there were 13 species of Leguminosae family plants found easily in Indonesia including *Cajanus cajan, Canavalia ensiformis, Mucuna pruriens, Arachis hypogaea, Vigna subterranea, Glycine max, Phaseolus vulgaris, Phaseolus lunatus, Vigna radiata, Vigna unguiculata* subsp. *unguiculata, Vigna angularis, Vigna unguiculata* subsp. *sesquipedalis*, and *Pisum sativum*. Among these species, several plants have been underutilized as food material, including *C. cajan, C. ensiformis, M. pruriens,* and *P. lunatus*. These 13 legume plants generally contain carbohydrates, proteins, starch, fats, and minerals, making them valuable as potential food sources. They also predominantly contain secondary metabolites, such as polyphenols and flavonoids (e.g., genistein, daidzein, cajanin), which have significant potential to be developed into pharmacologically active compounds.

ARTICLE HISTORY

Received: June 2024
Revised: August 2024
Accepted: March 2025

Keywords: *bioactive compound; fabaceae; leguminosae; legume seeds; potential medicine*

**corresponding author*
Email: kartini@staff.ubaya.ac.id

INTRODUCTION

Leguminosae, also known as legumes, are the third largest plant family, consisting of 770 genera and 19,400 species distributed worldwide, including Indonesia (Sandeep, 2014). The province of West Java is rich in Leguminosae, serving as a source of food, building materials, ornamental plants, and medicinal resources (Rahmah & Setiawan, 2023). These plants are characterized by pod-shaped fruits originating from a single leaf or without false partitions (Sutjaritjai et al., 2019). Furthermore, legume seeds play a significant role in the human diet, ranking as the second-largest food source after cereals, and are widely used for various natural products, such as flavorings and colorings. These plants have also been used for treatment, particularly in the form of concoctions with other ingredients capable of providing safe and effective therapeutic effects (Ahmad et al., 2016). These benefits and bioactivities are mediated by the rich phytochemicals contained in legume seeds, including primary and secondary metabolites. Primary metabolites in seeds, such as carbohydrates, fats, proteins, amino acids have a major contribution to their role as a nutritious diet. Phenolic compounds are known as the largest secondary metabolites found in Legumes that are excellent as chemopreventive agents, mainly due to their antioxidant properties (Singh et al., 2017; Spanou et al., 2010). Phenolic compounds can act as antioxidants due to their chemical structure that has reducing properties (Zillich et al., 2015).

This review aimed to explore 13 plant species from the Leguminosae family, including *Cajanus cajan, Canavalia ensiformis, Mucuna pruriens, Arachis hypogaea, Vigna subterranea, Glycine max, Phaseolus vulgaris, Phaseolus lunatus, Vigna radiata, Vigna unguiculata* subsp. *unguiculata, Vigna angularis, Vigna unguiculata* subsp. *sesquipedalis,* and *Pisum sativum*. These thirteen legume species were selected because they are commonly consumed and cultivated in Indonesia and have been reported to possess promising nutritional and medicinal potential in previous studies. The analysis focuses on the study of the plant distribution, nutrient content, the uses as food ingredients, and phytochemicals and biological activities. This work involved more than 100 articles to complete this review article. This review was compiled through various literature databases. The results are expected to be used for further development of local Indonesian legume seeds as a source of food and potential medicine.

Copyright @ 2025 by Authors. Published by Universitas Indonesia. This is an open access article distributed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (http://creativecommons.org/licenses/by-nc/4.0/), which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original author, and source are properly cited.

Table 1. Activity test results of 13 *Leguminosae* seeds extract

Seed material	Sample	Activity	Test Method	Result	Ref.
C. cajan	Methanol extract	Antioxidant	FRAP assay	IC_{50}: 49.08 ± 55 g/mL	(Khanum et al., 2015)
	Ethanol extract	Antioxidant	DPPH radical scavenging assay	IC_{50}: 22.96%	(Sharma et al., 2019)
	Ethanol extract	Antioxidant, anti-inflammatory	DPPH radical scavenging assay FRAP assay Albumin denaturation assay	IC_{50} against DPPH: 478.285 ± 0.123 µg/mL IC_{50} against FRAP: 0.219 ± 0.002 mM IC_{50} as anti-inflammatory: 677.1 ± 0.331 µg/mL	(Shamsi et al., 2018)
C. ensiformis	Methanol extract	*In Vitro*, α-glucosidase inhibition	Antidiabetic	IC_{50}: 24.91 ± 0.84 mg/mL	(Sutedja et al., 2020)
	Methanol extract	DPPH radical scavenging assay	Antioxidant	Scavenging: 38.04-68.51%	(Doss, Pugalenthi, & Vadivel, 2011)
	Water extract and methanol extract	*In vitro* on earthworms	Anthelmintic	The anthelmintic activity of the sample is comparable to the standard medicine (piperazine citrate 1 mg/mL)	(Kotkar et al., 2020)
M. pruriens	Ethanol extract	Spermatozoa motility enhancer	*In vivo* using *Mus musculus* BALB/c (albino mice)	Increased motility and percentage of normal spermatozoa	(Winarni, Judiwati, Prajogo, & Hayati, 2011)
	Ethanol extract	Anti-inflammatory	*In vitro* using RAW 264.7 cells	Decreased iNOS by 78.73% and COX-2 by 75.05%	(Han, Bae, & An, 2022)
	Ethanol: water (1:1) extract	Anti-parkinsonian	*In vivo* with *Mus musculus* and treated by hanging at a height of 50 cm, both front legs holding the wire	A dose of 5 mg/kg BW significantly reduced symptoms of catalepsy (can hang longer than 20 seconds)	(Sardjono et al., 2018)
A. hypogaea	Methanol extract	Renal protective agent	*In vivo* using Swiss Albino mice induced with gentamycin	The samples significantly reduced serum creatinine, urea, and BUN levels	(Gul et al., 2023)
	Petroleum ether extract	Antibacterial	*In vitro* against bacteria *S. aureus*, *P. aeruginosa, E. coli, E. hirae*, *L. ivanovii, L. inocua*, *B. subtilis* and *B. cereus*	Sterol content had inhibitory activity on most of the test bacteria	(Sebei, Gnouma, Herchi, Sakouhi, & Boukhchina, 2013)
	Water extract	Antioxidant	DPPH radical scavenging assay	At a concentration of 2 mg/mL, the sample had antioxidant activity with an inhibition of 57.43%	(Jiang, Ma, & Yan, 2014)

Table 1. Continued

Seed material	Sample	Activity	Test Method	Result	Ref.
V. subterranean	Ethanol extract	Antioxidant	DPPH radical scavenging assay FRAP assay	DPPH IC_{50}: 347 ± 4.2 µg/mL FRAP IC_{50}: 6.00 ± 0.21 mmol Fe2+/100 g	(Nyau et al., 2015)
	N-hexane extract	Antioxidant	DPPH radical scavenging assay	Scavenging: 67-72%	(Arise et al., 2016)
	Ethanol extract	Antioxidant Anti-inflammatory	DPPH radical scavenging assay FRAP assay Lipoxygenase inhibition assay	DPPH IC_{50}: 2.25 ± 0.14 µg/mL FRAP IC_{50}: 253 ± 33 µg/mL Lipoxygenase IC_{50}: 2.16 ± 0.14 µg/mL	(Chinnapun & Sakorn, 2022)
G. max	70% aqueous acetone extract	Antioxidant	DPPH radical scavenging assay	Inhibition: 46.71%	(Malenčić, Popović, & Miladinović, 2007)
	Methanol extract	Antiplasmodial and antimalarial	*In vivo* (*Plasmodium berghei* ANKA strain-infected mice)	IC_{50} against strain D6: 10.14±9.04 µg/mL IC_{50} against strain W2: 14.87±3.43 µg/mL Parasite inhibition activity: 72.9% at a dose of 800 mg/kg	(Nyandwaro et al., 2020)
	Methanol extract	Antibacterial	*In vitro* against *S. aureus, E. coli, P. alcaligenes, P. fluorescens*	200 µg/mL concentration had a zone of inhibition comparable to the standard (doxycycline)	(Arora et al., 2013)
	Ethanol extract of fermented seeds	Anticancer	MTT assay with T47D breast cancer cells	IC_{50}: 196.07 ± 15.96 µg/mL	(Yuliani et al., 2016)
	Steamed soybean	Antioxidant Anticancer	DPPH radical scavenging assay Anticancer activity using breast adenocarcinoma (MCF-7 cells)	Scavenging: 28.77 ± 3.82% Cell growth inhibition: 17.92 ± 1.24% at the extract concentration of 250 µg/mL	(Somdee et al., 2017)
P. vulgaris	Fermentation	Antioxidant	DPPH radical scavenging assay	IC_{50}: 434.51 ± 0.18 µg/mL	(Chalid et al., 2021)
	Methanol extract	Antiobesity	*In vitro*	Reduced intracellular triglyceride accumulation by 47.1% (1000 µg/mL) compared to controls	(Nassar et al., 2010)
	Ethanol extract	Antihypertensive	*In-vivo* using Male Wistar rats (180-200 g)	Reduced blood pressure significantly at an extract concentration of 100 mg/kg, intravenously	(Yuliani et al., 2016)

Table 1. Continued

Seed material	Sample	Activity	Test Method	Result	Ref.
P. lunatus	Water extract	Antioxidant Anti-inflammatory	TBARS *In-vitro* anti-inflammatory	Antioxidant activity: 33.19 ± 0.024% at an extract concentration of 1000 µg/mL Anti-inflammatory activity: 21.53 ± 0.39% at an extract concentration of 1000 µg/mL	(Tamayo et al., 2018)
	Methanol extract	Antioxidant	DPPH radical scavenging assay	IC_{50}: 1268.18 µg/mL	(Nugrahani et al., 2020)
	Ethanol extract	Antihypertensive	*In vitro* against ACE-I activity	Fraction >3 kDa had the highest ACE-I activity (60.15%, IC_{50}: 172.62 µg/mL)	(Ciau-Solís et al., 2018)
V. radiata	Methanol extract	Antioxidant	DPPH radical scavenging assay	IC_{50}: 73.35 µg/mL	(Tang et al., 2014)
	Methanol extract	Antibacterial	*In vitro* with gram-negative bacteria	MIC: 75 mg/mL	(Camalxaman et al., 2013)
	Mung bean fermentation (*Tempe*)	ACE inhibitor	*In vitro*	ACE-I: 75% with 18.68% hydrolysis degree (protein extract containing 351 mg/mL soluble protein)	(Muawanah et al., 2022)
V. unguiculata subsp. *unguiculata*	Sprout crude drugs after 12 hours of soaking	Antioxidant	DPPH radical scavenging assay	IC_{50}: 5,928.39 µg/mL	(S. W. K. Putri et al., 2021)
	Water extract	Antibacterial	*In vitro* (agar diffusion method against *Bacillus subtilis* and *Escherichia coli* bacteria)	Inhibition diameter of 22 mm at a concentration of 300 µg/mL extract, against gram-negative bacteria, namely *E. coli*	(Sandeep, 2014)
	Juice	Antihyperglycemia	*In vivo* with male Swiss Webster mice with alloxan induction	Juice at a dose of 12 g/kg BW has a significant antihyperglycemic effect compared to the positive control	(Cahyani et al., 2015)
V. angularis	Crude oil	Antimicrobial	Agar well technique against *Klebsiella pneumoniae, Bacillus subtilis, Proteus, S. typhi,* and *E. coli*	Diameter of inhibition of each bacteria: *E. coli*: 15 ± 0.40 cm *Proteus*: 1.00 ± 0.00 cm *K. pneumoniae*: 3.00 ± 0.03 cm *S. typhi*: 7 ± 0.01 cm *B. subtilis*: 5 ± 0.02 cm	(Olaseeni et al., 2023)
	Ethanol extract	ACE inhibitor	*In vitro*	ACE and angiotensin level II inhibitory activity at 500 mg/kg extract concentration	(Jeong et al., 2021)

Table 1. Continued

Seed material	Sample	Activity	Test Method	Result	Ref.
	Coat and seeds extract	Acetylcholinesterase inhibitor (Anti-Alzheimer)	*In vitro*	Inhibition at a concentration of 37,700 µg/mL: Seeds extract: 25.7% Seeds coat extract: 88.5%	(Johnson et al., 2023)
V. unguiculata subsp. *sesquipedalis*	Ethanol extract	Antihyperglycemia	*In vivo* using mice	There was a decrease in blood glucose levels of 167.00 mg/dL at a dose of 12 g/kg BW	(Harmayetty & Anisa, 2015)
	Water extract	Hair growth	*In silico* with molecular docking method	Flavonoid compounds have free energy bonds ranging from -8.44 to -5.07 kcal/mol	(Arifin et al., 2017)
	Ethanol extract	Antihyperglycemia	Oral glucose tolerance test in male Swiss Webster mice	Extract (13 g/kg BW) showed activity to reduce blood glucose in mice	(Sumarny, Musir, & Ningrum, 2013)
P. sativum	Ethanol extract	Antioxidant Antidiabetic	DPPH radical scavenging assay *In vivo* with mice fasted overnight (16 hours)	IC_{50} DPPH: 158.52 µg/mL Blood glucose levels were reduced by 30.24% at 30 minutes	(Zilani et al., 2017)
	Water extract	Anthelmintic	*In vitro* with earthworms	Paralysis time: 14.33 ± 1.30 minutes Time to death: 19.00 ± 1.48 minutes	(Devade, Mehta, Lohare, Tawakale, & Jadhav, 2022)
	Methanol extract	Antioxidant	DPPH radical scavenging assay	IC_{50}: 489.25 µg/mL	(Alam & Khatun, 2016)

Notes: FRAP – Ferric Reducing Antioxidant Power, DPPH – 2,2-Diphenyl-1-picrylhydrazyl, TBARS – Thiobarbituric Acid Reactive Substances, ACE-I – Angiotensin-Converting Enzyme Inhibitor, iNOS – Inducible Nitric Oxide Synthase, COX-2 – Cyclooxygenase-2, MTT – 3-(4,5-Dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide, MIC – Minimum Inhibitory Concentration, IC_{50} – Half Maximal Inhibitory Concentration, BUN – Blood Urea Nitrogen, BW – Body Weight

METHODS

In this study, established references and databases, including PubMed, Google Scholar, and ScienceDirect, were selected to conduct a comprehensive study of local Indonesian legume seeds. This study was focused on their distribution, utilization as food ingredients, phytochemical composition, and bioactive properties. The articles that met the criteria were included, such as relevance to the topic discussed (about distribution, phytochemical, and bioactivity of legume seeds); published in peer-reviewed journals between 2010 and 2024; and provided experimental or review data related to the topic. The selection of literature prioritized the latest research published in reputable journals to ensure data reliability, whereas the irrelevant articles or those published in non-indexed journals were excluded. Literature searches were conducted using both single and combined keywords. In this study, the examples of keywords and Boolean operators used to assist literature searches include "Leguminosae AND Bioactivity," "Leguminosae AND Medicinal Potential," and "Potential Medicinal Activity of Legumes."

RESULTS AND DISCUSSION

Cajanus cajan

Cajanus cajan (Pigeon Pea) (Figure 1), locally called *Gude* in Indonesia, is widely distributed across tropical areas such as Asia, India, and Africa (Fuller et al., 2019).

Figure 1. *Cajanus cajan* with plant parts: leaves (a), fruits with the flower (b), seeds (c), and whole plant (d) (Tungmunnithum & Hano, 2020)

Nutrients and Uses

C. cajan contains high nutrients compared to other legumes, including protein (20-22%), carbohydrates (65%), and low fat (1.2%) (Utami et al., 2015). Its seeds can be processed into flour and used as an ingredient in various food products. Its seeds also can be processed into nutritious food products and sources of protein that have the potential to reduce malnutrition and protein deficiency in the body (Karri & Nalluri, 2017).

Phytochemical and Bioactivity

Traditionally, this plant seed is also used to cure various diseases, with the main biological activity such as antioxidant and anti-inflammatory (Tungmunnithum et al., 2021; Tungmunnithum & Hano, 2020). In the medical fields, *C. cajan* has properties as an antimalarial with the cajachalcone as an active compound with the IC_{50} value of 2.0 µg/mL (7.4 µM) (Ajaiyeoba et al., 2013; Suhaema & Widiada, 2023). It is also reported as anthelmintic (Adama et al., 2016).

Table 1 shows the potential of *C. cajan* seeds as an antioxidant product, which can causing chronic diseases (Tungmunnithum & Hano, 2020; Gargi et al., 2022). In a previous study, ethanolic extract of its seeds showed concentration-dependent antioxidant activity using the DPPH scavenging method (Shamsi et al., 2018; Sharma et al., 2019). In addition, the methanolic extract also showed the higher antioxidant activity using FRAP method than ethanolic extract (Khanum et al., 2015; Shamsi et al., 2018). According to the "like dissolves like" principle, flavonoid compounds are more likely to be dissolved into polar solvents in the extraction process. Methanol has higher dielectric constant (ε_r) value of 33.640 compared to ethanol, which has an ε_r value of 25.16 (Putri et al., 2023).

Previous studies have assessed the ability of protease inhibition by *C. cajan* seed extract, considering protein denaturation as a primary cause of inflammation. The results showed that ethanol extract was effective in inhibiting thermally induced albumin denaturation, with an IC_{50} value of 677.1 ± 0.331 µg/mL and a maximum inhibition of 65.52 ± 0.43% at the concentration of 1000 µg/mL (Shamsi et al., 2018). The mechanism of anti-inflammatory action by the ethanol extract was through inhibition of neutrophil release from lysosomes at the inflammation site, which, if released extracellularly, would cause inflammation and tissue damage (Tušar et al., 2021). Due to this protein protease inhibitory (PPI) activity, thus forming a stable complex with the target proteinase by changing, blocking, or preventing access to the active site of the enzyme (Shamsi et al., 2018). The proteinase inhibitor from *C. cajan* mentioned in the previous study is a Kunitz-type proteinase inhibitor (Haq & Khan, 2003). These compounds work by reducing the proteolytic activity of proteases, then forming a stable complex with the target proteinase by changing, blocking, or preventing access to the active site of the enzyme (Shamsi et al., 2017). *C. cajan* seed has shown potential to be a promising source of medicinal compounds for further development.

Canavalia ensiformis

Canavalia ensiformis (Jack Bean) commonly known as *koro* in Indonesia (Figure 2), originated from Central and South America, which has historically been used as a source of protein (Sheahan, 2012).

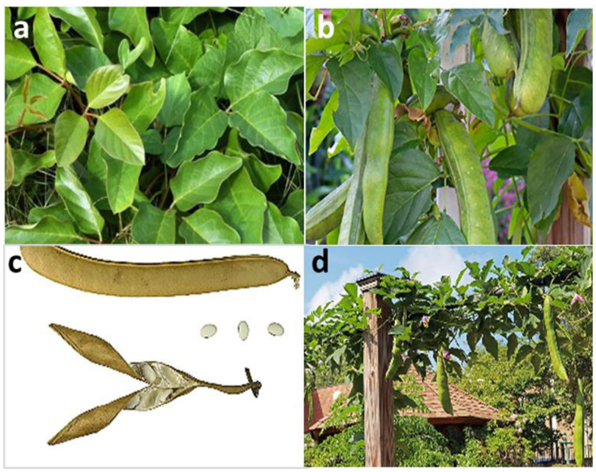

Figure 2. *Canavalia ensiformis* with plant parts: leaves (a), fruits with the leaves (b), seeds (c), and whole plant (d) (Ventosa, 2022)

Nutrients and Uses

As a type of large-seeded legume, *C. ensiformis* seeds have recently been used as a food source, with seeds rich in protein and amino acids (Puspitojati et al., 2023). *C. ensiformis* seeds contains protein of 30% to 36.40%, fat (5.85% - 9.23%), fiber (3.25% - 6.35%). *C. ensiformis* can be processed into food ingredients such as plant-based milk (Mahardhika et al., 2023). In addition, *C. ensiformis* seeds can be processed into several other food products such as flour and processed products such as bakery products and additional ingredients in the fermentation of various traditional foods (Widiantara & Cahyadi, 2018).

Phytochemical and Bioactivity

This plant seed also contains bioactive compounds such as tannins, saponins, flavonoids, and cardiac glycosides. Four major flavonoid compounds have been detected and identified from *C. ensiformis* as kaempferol glycosides with three or four glycoside units (Sutedja et al., 2020). The bioactive compounds show the potential of *C. ensiformis* seeds for treating various diseases, including vomiting, obesity, stomach pain, and anthelmintic (Kotkar et al., 2020) and potential antioxidant (Yusuf et al., 2023).

Previous tests have shown that *C. ensiformis* seeds have antioxidant, antidiabetic, and anthelmintic activity (Table 1). The antioxidant test was conducted using the DPPH method, which produced an inhibition ranging from 38.04 to 68.51% (Tristantini et al., 2016). Furthermore, another test was conducted using the ABTS method, with results showing a very strong antioxidant activity, which produced an inhibition ranging from 36.31 to 86.63% and IC_{50} value is 32.62 ppm (Yusuf et al., 2023; Apriandini et al., 2023). *C. ensiformis* seeds also have α-glucosidase inhibitory activity, which is caused by the presence of anisole groups. Among the bioactive compounds suspected of having anisole groups is the kaempferol glucoside, which possesses a similar ability to inhibit α-glucosidase activity (Sutedja et al., 2020). Another study revealed that *C. ensiformis* seeds contain several metabolites, namely l-canavanine, xanthotoxin, cis-aconitic acid, trans-aconitic acid, malic acid, citric acid, palmitic acid and S-carboxymethylcysteine, all of which have been confirmed to have nematotoxic activity (Rocha et al., 2017).

Mucuna pruriens

Mucuna pruriens (velvet beans) or *kacang benguk* (Figure 3), is widely distributed worldwide in tropical and subtropical regions (Lampariello et al., 2012). In Indonesia, *M. pruriens* can be found in all regions with different regional names, including *kacang babi* or *kowas* (Sunda), *kekara juleh* (Maluku), and *bhengok* (Madura) (Mulyani et al., 2016).

Figure 3. *Mucuna pruriens* with plant parts: leaves (a), fruits with the plant (b), seeds (c), and whole plant (d) (Mulyani et al., 2016)

Nutrients and Uses

This plant seed is rich in various nutrients, with every 100 g seeds comprising 28 mg protein, 689.45 mg calcium, 6.12 mg zinc, 341 mg magnesium, and other components (Baby et al., 2023). In Indonesia, *M. pruriens* seed is fermented into *tempe benguk*, serving as an energy producer that can be boiled to obtain aphrodisiac properties (Mulyani et al., 2016).

Phytochemical and Bioactivity

M. pruriens seed contains bioactive compounds such as L-DOPA, tannin, flavonoid, and phenolic compound (Chinapolaiah et al., 2019). Traditionally, this plant seed has been used in Indian Ayurvedic medicine for treating Parkinson's disease, nerve disorders, and arthritis (Murthy et al., 2016).

In vitro and *in vivo* studies of *M. pruriens* seeds extracts have shown significant application across various fields (Table 1), ranging from food to potential medicine sources, as anti-inflammatory, neuroprotective, antioxidant, and anti-parkinson (Lampariello et al., 2012). The activity of reducing cataleptic symptoms has been correlated with the content of L-Dopa compounds in the seeds (Pathania et al., 2020; Sardjono et al., 2018). This L-dopa serves as a dopamine precursor that can alleviate cataleptic symptoms, through the action of the enzyme DOPA decarboxylase, which occurs in the central nervous system and peripheral circulation (Liu et al., 2016). In addition, L-dopa compounds can also be used as an anti-inflammatory by inhibiting the inflammatory response and the release of mediators such as NO and COX-2 (Pathania et al., 2020). Furthermore, *M. pruriens* also has antidiabetic activity due to the presence of cyclitol compounds which have an insulin mimetic effect from d-chiro-inositol which is a new signaling system for controlling glucose metabolism (Lampariello et al., 2012).

Arachis hypogaea

Arachis hypogaea, or peanut, is a legume that belongs to the Leguminosae family (Figure 4) (Chen et al., 2019). In Indonesia, *A. hypogaea* is found in Java, Nusa Tenggara, Sulawesi, South Sumatra, and North Sumatra (Samosir et al., 2020).

Figure 4. *Arachis hypogaea* with plant parts: leaves (a), fruits (b), seeds (c), and whole plant (d) ((Prasad, Kakani, & Upadhyaya, 2010) and personal collection)

Nutrients and Uses

Generally, the seeds of *A. hypogaea* can be used as food, with the oil extract serving as cooking ingredients, in bakery products, and as jam. Additionally, the oil that came from the seeds is processed into margarine through discoloration and deodorization processes (Ahmad et al., 2019). Other identified components include unsaturated fatty acids that contribute to the maintenance of optimal metabolic control in diabetes patients, leading to the recommendation of food with high monounsaturated fatty acids (Park et al., 2017). Consumption of 100 g of *A. hypogaea* seeds can provide approximately 75% of the recommended dietary allowances (RDA) for niacin, 60% for folate, 53% for thiamine, 10% for riboflavin, 35% for pantothenic acid, 27% for pyridoxine, and 55.5% for vitamin E (Singh et al., 2021).

Phytochemical and Bioactivity

The seeds contain arginine, resveratrol, phytosterols, phenolic acids, and flavonoids. *In vivo* and *in vitro* analyses of *A. hypogaea* seeds showed antioxidant, antibacterial, and renal protective agent effects (Table 1), where resveratrol had the most significant biological activity (Mingrou et al., 2022). These seeds serve as sources of resveratrol, with approximately 73 μg found in every 100 g seeds. Resveratrol belongs to the stilbene group, is synthesized by the enzyme resveratrol synthase, and has the potential for renal protection by inhibiting platelet aggregation (Hasan et al., 2013).

Vigna subterranea

Vigna subterranea (Figure 5), commonly referred to as Bambara groundnut originated from Africa and has adapted to various regions in Indonesia as Bogor Nut (Sasnia et al., 2021).

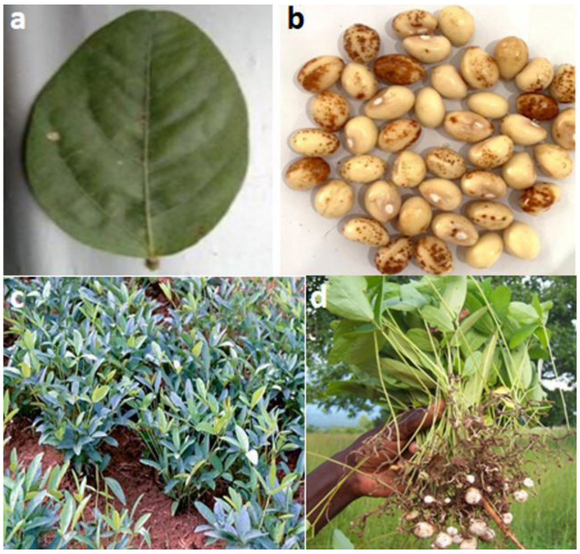

Figure 5. *Vigna subterranea* with plant parts: leaves (a), seeds (b), whole plant (c), and fruits with the plant (d) ((Heuzé, Tran, & Lebas, 2020; Surahman, 2023) and personal collection)

Nutrients and Uses

V. subterranea seeds contain 19.28-20.60% protein, 56.25-61.01% carbohydrates, 6.60-8.49% fat, 184.0 mg calcium, 4.40 mg iron, 45.7 mg potassium, and 9.14 mg sodium. Due to the abundant nutritional content, the seeds can be an alternative food source (Sasnia et al., 2021). Other compounds found in *V. subterranea* seed include 32.7% essential amino acids consisting of lysine, histidine, arginine, leucine, and isoleucine, as well as 66.1-70.8% non-essential amino acids comprising methionine, glycine, cysteine, tyrosine, and proline (Mohammed et al., 2016).

Phytochemical and Bioactivity

The seeds also contain various bioactive phenolic compounds such as quercetin, quercitrin, kaempferol, rutin, myricetin, and luteolin. Generally, polyphenols are naturally occurring organic substances and are secondary metabolites that protect plants from reactive oxygen species, photosynthetic stress, or protein aggregation. With a wide range of bioactive compounds, the plant has a variety of pharmacological potentials, including antimicrobials, antioxidants, and anti-inflammation, as well as enzyme inhibition (Udeh et al., 2020).

Table 1 shows the potential of *V. subterranea* as a natural antioxidant (Chinnapun & Sakorn, 2022). Previous studies also stated that *V. subterranea* seeds have antioxidant activity, both of which also used the DPPH scavenging method as a testing method (Arise et al., 2016; Nyau et al., 2015). Previous study reported that the high content of phenolic compounds in the seeds is responsible for the antioxidant activity (Xu & Chang, 2008). Generally, phenolic compounds have health benefits by acting as free radical scavengers, reducing the potency of free radical compounds, chain-breaking agents, and altering signal transduction pathways (Ramatsetse et al., 2023).

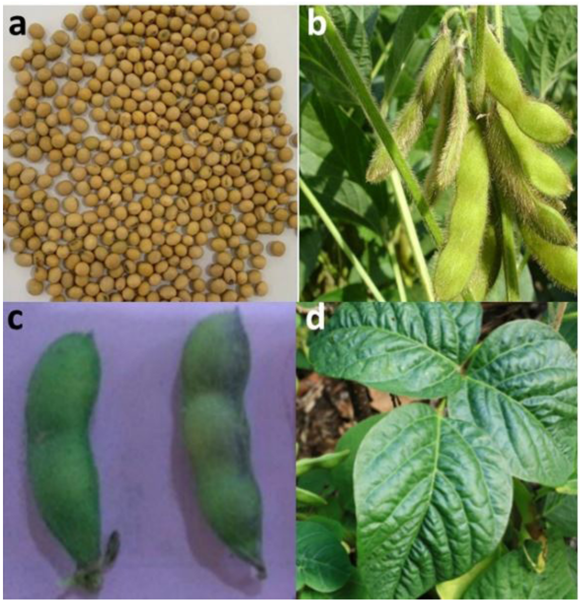

Figure 6. *Glycine max* with plant parts: seeds (a); fruits with the plant (b), fruits (c), and leaves (d) ((Ngawi, 2023) and personal documents)

Glycine max

Glycine max or soybean (Figure 6) is a plant cultivated from 4000-5000 years ago, which is widely distributed in China, Japan, and Korea. The seeds are widely consumed as food in Indonesia, with an annual consumption rate of approximately 2.24-2.5 million tons (Ningsih et al., 2019).

Nutrients and Uses

G. max is an important food source, particularly in the traditional cuisines of Southeast Asian communities. In Indonesia, this legume is usually consumed in the form of *tempe*, tofu, and soybean juice, with high content of various nutrients, such as protein (40%) and oil (18%) per 100 grams of soybean seeds (Sefrila et al., 2023).

Phytochemical and Bioactivity

Additionally, soybean contains polysaccharides, phytosterols, lecithin, saponins, and flavonoids, particularly isoflavones. Soybean is claimed by the Food and Drug Administration (FDA) as a food that can reduce coronary heart disease. Soybean can also improve health and reduce the incidence of diseases such as diabetes, hypertension, hyperlipidemia, obesity, and inflammation (Modgil et al., 2021). Genistein, a flavonoid compound present in the seeds, can be used as a protein kinase inhibitor that inhibits the invasion of pathogenic bacteria in mammalian epithelial cells (Choi et al., 2018).

Genistein is an isoflavone compound with anticancer activity in several tissues, including the liver, breast, and colon, serving as a phytoestrogen (Yuliani et al., 2016). The mechanism of action of genistein as an anticarcinogenic is by inducing apoptosis and inhibiting cancer cell proliferation. Anticarcinogenic properties are also often shown through antioxidant effects by reducing oxidative stress. In a previous study, the levels of genistein in *G. max* products were found to vary between 3.43-32.02 μg/g (Somdee et al., 2017). The antiplasmodial activity of this legume by causing oxidation of red blood cells or inhibiting protein synthesis depends on the phytochemical content. Furthermore, flavonoids were found in the seeds, showing antiplasmodial activity by chelating nucleic acid base pairs from parasites (Nyandwaro et al., 2020). Dependent-dose antibacterial activity was also found in the seed extract against gram-positive and negative bacteria, showing several compounds such as coumaric, ferulic, and vanillic acid (Arora et al., 2013).

Another isoflavone from *G. max* (soybean) with potential antioxidant activity is daidzein. Daidzein is an aglycone isoflavone known for its strong ability to neutralize free radicals and is readily absorbed by the small intestine. This effective absorption is due to aglycone isoflavones, which are part of the flavonoid group and have optimal bioavailability (Jannah et al., 2020).

Phaseolus vulgaris

Phaseolus vulgaris (common bean) or green bean (Figure 7) is a legume widely used in traditional foods, particularly in Asian countries. Serving as an annual and perennial plant, mostly found in warm and tropical countries, this plant is used as a traditional food and for decoration purposes (Nassar et al., 2010). It is also a favored legume, characterized by sweet tastes and delicious, serving as a source of vegetable protein.

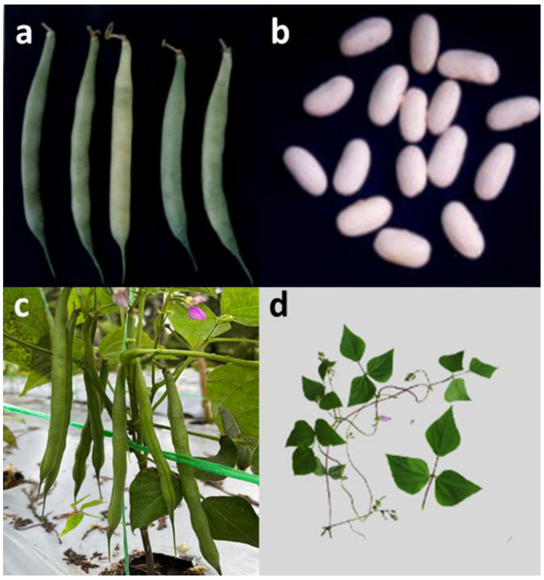

Figure 7. ***Phaseolus vulgaris*** **with plant parts: fruits (a); seeds (b), fruits with the plant (c), and whole plant (d) (Nassar et al., 2010)**

Figure 8. ***P. lunatus*** **with plant parts: leaves (a), fruits with the plant (b), seeds (c), and whole plant (d) ((Munip, 2009) and personal collection)**

Nutrients and Uses

The numerous nutrients contained in the 100 gram seeds include starch (9.16-18.09%), protein (22.06-32.63%), lipid (1.05-2.83%), and sugar (1.55-9.07%). Therefore, it is widely used as a versatile food ingredient for bakery products, salads, and canned foods (Kan et al., 2017).

Phytochemical and Bioactivity

P. vulgaris seed also contains various phytochemical compounds that have potential in pharmacological fields such as cancer and diabetes (Saad et al., 2021). These compounds include phenolic acids (ferulic and coumaric), flavonoids (myricetin), flavanols (catechins), isoflavones (genistein), anthocyanins (delphinidin and cyanidin), and proanthocyanidins (Rodríguez et al., 2022).

P. vulgaris seed has been widely analyzed and reported to have a variety of potential including antioxidant, antiobesity, and antihypertensive, as shown in Table 1. The antioxidant activity is attributed to isoflavones content, the most abundant major subclass of flavonoids (Abu-Reidah et al., 2013). A previous study conducted DPPH radical scavenging tests, which obtained an IC_{50} value of 434.51 µg/mL (Chalid et al., 2021). The seeds have also shown a potential to be used as an antihypertensive candidate due to their action on the renin-angiotensin system. The ingredients that are responsible for this activity are flavonoids and saponins (Yuliani et al., 2016).

Phaseolus lunatus

Phaseolus lunatus or butter bean (Figure 8), commonly known as *kacang lima* in Indonesia, is indigenous to tropical America. This leguminous plant shows a vining growth pattern and is predominantly cultivated in temperate and subtropical regions of Africa and Southeast Asia (Palupi et al., 2022).

Nutrients and Uses

The seeds contain various nutrients including protein, carbohydrates, and minerals such as calcium, zinc, calcium, and iron, which are often consumed by the community both in pods and dried form (Bria, 2017). A crude protein level of 23.17 g/100 g, an actual protein value of 19.57 g/100 g, a sizable amount of total carbs (71.14 g/100 g), and minerals similar to regularly consumed staple meals were all revealed by analysis based on fresh weight. The overall sugar and starch contents were 4.48 and 67.72 g/100 g, respectively, while the crude fat level was 0.21 g/100 g (Ezeagu & Ibegbu, 2010). Peas can be used as green vegetables or processed in dry form as beans. They can be cooked before consumption or can be eaten fresh (Sood & Gupta, 2017).

Phytochemical and Bioactivity

Various bioactive compounds have also been identified, including alkaloids, flavonoids, saponins, phenols, and triterpenoids (Nugrahani et al., 2020). Generally, the leaves and stems are used as green fertilizer and animal feed (Bria, 2017), while the seeds are applied in pharmacology as antimicrobials, antioxidants, and anti-inflammatories (Tamayo et al., 2018).

P. lunatus seeds extracts have been evaluated for pharmacological activity and have shown various potentials (Table 1). Phenolic compounds in these extracts serve as anti-inflammatory agents by inhibiting COX-1 and COX-2. The antihypertensive activity is mediated by the inhibition of the angiotensin-converting enzyme (ACE) (Ciau-Solís et al., 2018), while flavonoids and saponins function as antihypertensives. The seed extract includes irreversible inhibitors of the enzyme nitric oxide synthase (NOS), capable of decreasing the production of nitric oxide, which plays a role in increasing blood pressure. This is due to endothelial dysfunction, a pathological condition associated with hypertension and oxidative stress. A significant decrease in nitric oxide activity in the vascular wall due to reduced NO production and high degradation can lead to an endothelium-dependent vasodilatory loss response. Therefore, one of the prevention of cardiovascular disease, particularly hypertension, is aimed at preventing endothelial dysfunction (Puzserova & Bernatova, 2016).

Vigna radiata

Vigna radiata or mung bean (Figure 9), is a widely consumed legume in Asia. This plant is relatively resistant to drought and is widely cultivated in many countries in Asia including China, India, Bangladesh, Pakistan, and Indonesia. *V. radiata* also thrives in dry regions such as Southern Europe and warm regions in Canada and the United States (Hou et al., 2019).

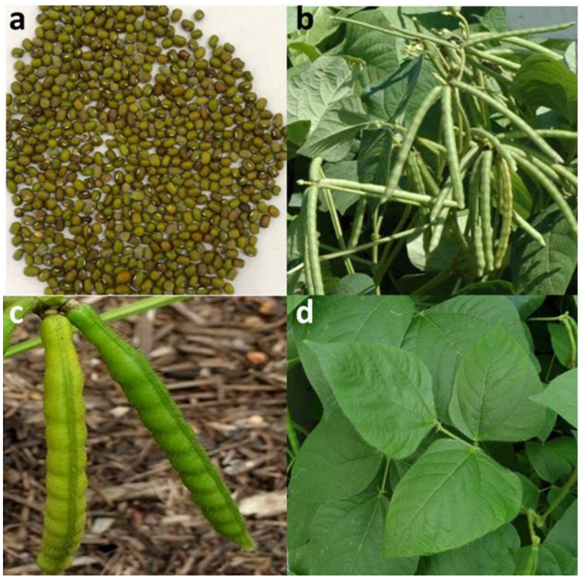

Figure 9. *V. radiata* with plant parts: seeds (a), fruits with the plant (b), fruits (c), and leaves (d) ((Ganesan & Xu, 2018) and personal documentation)

Nutrients and Uses

The seeds contain high protein (22-27%) and amino acids (76%) calculated based on the Food and Agriculture Organization of the United Nations (FAO) guidelines (Yi-Shen et al., 2018). *V. radiata* can be processed into various food products such as dhal, sweets, snacks, savory foods, cakes, bean sprouts, noodles, and soups (Dahiya et al., 2015).

Phytochemical and Bioactivity

The biological activity contained in the seeds includes antioxidant, antimicrobial, anti-inflammatory, antidiabetic, antihypertensive, and antitumor (Table 1). Thus, it has shown good potential to be used as an alternative to conventional medicines for disease prevention. The bioactive compounds include amino acids, polyphenols, phytosterols, and polysaccharides. Some of the polyphenols contained are ferulic acid, gallic acid, and p-coumaric acid, while the flavonoid compounds include quercetin, apigenin, scopoletin, and delphinidin (Tang et al., 2014).

The potential of *V. radiata* seed for detoxification has been identified due to the presence of proteins, tannins, and polyphenols. The antioxidant activity has been shown through the DPPH free radical scavenging method, with seeds extract indicating high free radical scavenging ability (IC_{50}: 73.35 µg/mL) due to the presence of vitexin and isovitexin compounds (Tang et al., 2014). Specifically, vitexin compounds can inhibit DPPH radicals by approximately 60% at a 100 g/mL, effectively fighting free radicals and preventing damage or cell death due to ultraviolet light exposure (Cao et al., 2011).

V. radiata seeds were also found to have inhibitory activity against ACE, resulting in a decrease in the conversion of plasma angiotensin-I to angiotensin-II, which contributes to an increase in blood pressure. The ACE inhibition value of fermented *V. radiata* seeds extract is 75% in protein containing soluble protein of 351 mg/mL with a degree of hydrolysis at 18.68% (Muawanah et al., 2022; Sonklin et al., 2020). Furthermore, inhibition of ACE leads to the control of systolic blood pressure, indicating potential use as an antihypertensive agent.

The antibacterial potential of *V. radiata* seeds methanol extract was evaluated against gram-negative bacteria including *Pseudomonas aeruginosa, Escherichia coli,* and *Salmonella spp*. The MIC value of the extract was comparable to standard antimicrobials, showing potential application as a natural source of antibacterial agents (Camalxaman et al., 2013).

Vigna unguiculata subsp. *unguiculata*

Vigna unguiculata subsp. *unguiculata* (black-eyed peas) or *kacang tunggak* (Figure 10) is a legume originating from West Africa, which is widely distributed across tropical and subtropical areas. This legume is classified as a food crop and industrial raw material (Sayekti & Prajitno, 2012).

Nutrients and Uses

The seeds of *V. unguiculata* subsp. *unguiculata* can be used as a food source, while the leaves are processed into functional vegetables that can be consumed and have various nutritional values. The seeds can be used as a cold remedy and coffee substitute (Siddhuraju & Becker, 2007), containing various nutrients such as protein (22-30%) and carbohydrates (33-59%) (Fadillah & Purnamawati, 2020). *V. unguiculata* subsp. *unguiculata* can be processed into various food ingredients such as flour, *tempe* and even used as a substitute for soybeans as the main ingredient in making soy sauce (Miftahul & Sopandi, 2016).

Figure 10. *V. unguiculata* subsp. *unguiculata* with plant parts: seeds (a), fruits with the plant (b), fruits (c), and leaves (d) ((C. M. Sheahan, 2012) and personal documentation)

Phytochemical and Bioactivity

Compared to soybeans, *V. unguiculata* subsp. *unguiculata* seed has lower fat content, along with other essential compounds such as aspartic acid, lysine, and glutamate (Wulandari et al., 2020). Bioactive compounds contained in this legume are tannins (0.18-0.59%), phenolic acids such as p-hydroxybenzoic acid, protocatechuic acid, 2,4-dimethoxybenzoic acid, and cinnamic acid derivatives, including p-coumaric acid, caffeic acid, and ferulic acid (Siddhuraju & Becker, 2007). The seeds have various activities such as antioxidant, anticarcinogenic, and antimicrobial (Diniyah & Lee, 2020).

V. unguiculata subsp. *unguiculata* seed extract showed concentration-dependent antibacterial activity against *E. coli* bacteria (Sandeep, 2014). Antihyperglycemic activity tests in mice showed that the seeds have significant activity, characterized by a decrease in blood glucose at 264 mg/dL (Cahyani et al., 2015).

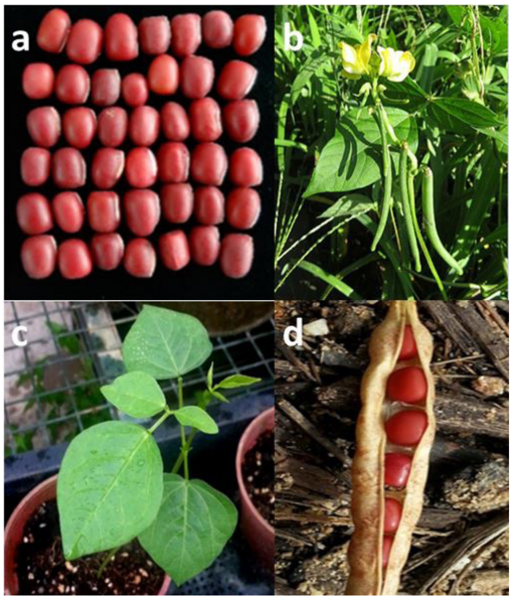

Figure 11. *V. angularis* with plant parts: seeds (a), fruits with the plant (b), leaves (c), and fruits (d) (Wang et al., 2022)

Vigna angularis

Vigna angularis (Figure 11) commonly called kidney bean, originates from China and is widely distributed across several regions including Africa, Europe, and the Americas (Wang et al., 2022). Furthermore, *V. angularis* is also known as adzuki beans, characterized by a uniform red color, and has been cultivated for centuries in the Eastern region and Northeast Asia (Pandiyan et al., 2021).

Nutrients and Uses

V. angularis seed contains 310 calories per 100 grams of 24-35% protein, 48-53% carbohydrates, 0.6-2% fat, and 2.3-4.4% minerals (Simarmata, 2023). *V. angularis* seed is usually consumed as a complementary food ingredient for rice. In addition, *V. angularis* seed has been developed by mixing bean flour with cereal flour to make raw materials for gluten-free diet biscuits, bread, cookies and other nutritious foods (Wang et al., 2022).

Phytochemical and Bioactivity

The seeds contain bioactive compounds such as quercetin, myricetin, procyanidin, rutin, catechin, gallic acid, ferulic acid, and kaempferol (Wang et al., 2022). In Northeast Asia, the seeds are used as traditional medicine to maintain health and control weight (Liu et al., 2017). Furthermore, the seeds have antioxidant, antibacterial, and protective effects against aging and neurodegenerative (Bak et al., 2023).

Various *in vitro* analyses have shown the pharmacological potential of *V. angularis* seed, containing biologically active phytochemical compounds such as the flavonoid quercetin, which has potential as an antioxidant, antihypertensive, and anti-alzheimer's agent (Jeong et al., 2021; Johnson et al., 2023; Olaseeni et al., 2023). Additionally, its seeds contain important bioactive compounds such as flavonoid, tannin, and alkaloid that have potential ACE inhibitor activity compared to drug standards. These compounds play a role in hydrogen bonding on the active site of ACE, with a competitive inhibitor mechanism of action, forming a chelate complex that can precipitate proteins (Jeong et al., 2021).

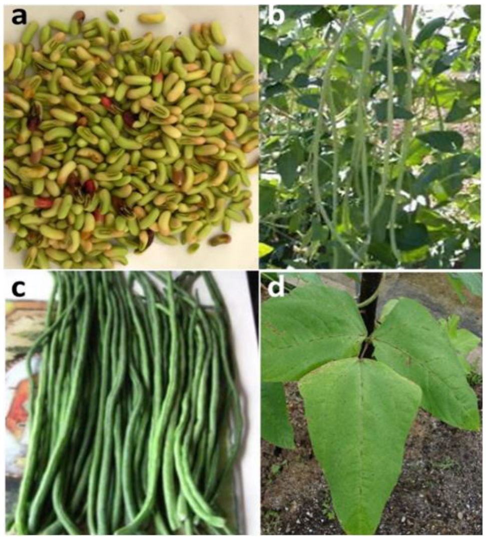

Figure 12. *Vigna unguiculata* subsp. *sesquipedalis* with parts: seeds (a), fruits with the plant (b), fruits (c), and leaves (d) ((C. M. Sheahan, 2012) and personal documentation)

Vigna unguiculata subsp. sesquipedalis

Vigna unguiculata subsp. *sesquipedalis* is a very popular legume in Indonesia, known as *kacang panjang* or asparagus beans (Figure 12). This legume is also called *yardlong* beans, originating in India and China (Zaevi et al., 2014).

Nutrients and Uses

V. unguiculata subsp. *sesquipedalis* seed is a source of vegetable protein. The protein content in long beans is quite high, namely 22.3% in dry bean seeds, 4.1% in leaves and 2.7% in young pods. In addition to being a source of protein, long beans also contain other nutritional compositions, namely thiamine, vitamin A, riboflavin, iron, phosphorus, potassium, ascorbic acid, folic acid, magnesium and manganese (Kaswinarni et al., 2014). In addition, long bean plants have an important role in fertilizing the soil due to their root nodules that can bind free nitrogen from the air (Umami et al., 2019).

Phytochemical and Bioactivity

The seeds contain various nutrients and phytochemical compounds, including tannins, alkaloids, saponins, cardiac glycosides, flavonoids, and phlobatannin (Firdousi et al., 2021). Furthermore, the fresh seeds are very rich in folate, which important to pregnancy. Other essential contents include protein (23-32%), and tryptophan, with numerous vitamins and minerals (Quamruzzaman et al., 2022). The seeds have also been used to treat breast cancer, leukemia, and antivirals to prevent immune system disorders. Additionally, the high insoluble fiber content makes *V. unguiculata* subsp. *sesquipedalis* applicable for treating diabetes mellitus (Ivantirta, 2019).

V. unguiculata subsp. *sesquipedalis* seeds contain various bioactive compounds such as flavonoids, alkaloids, sterols, saponins, and tannins, which are responsible for antihyperglycemic (Harmayetty & Anisa, 2015) and hair growth (Arifin et al., 2017). Based on previous research, the phenolic content of *V. unguiculata* subsp. *sesquipedalis* at 93.59 mg GAE/100 g, was found to be higher than that of mung beans at 43.91 mg GAE/100 g (Arinanti, 2018). The protective effect is also caused by flavonoids, which transfer hydrogen or electrons, and reduce alpha-tocopherol radicals to inhibit oxidase (Ivantirta, 2019). *V. unguiculata* subsp. *sesquipedalis* shows antibacterial effects in addition to antioxidant properties, particularly against gram-negative bacteria like *Escherichia coli* (Sandeep, 2014).

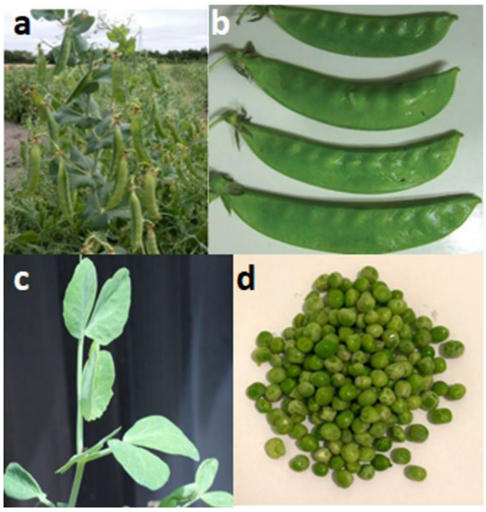

Figure 13. *P. sativum* with parts: fruits with the plant (a), fruits (b), leaves (c), and seeds (d) (Pavek, 2012; Rungruangmaitree & Jiraungkoorskul, 2017)

Pisum sativum

Pisum sativum (pea) or *kacang ercis* (Figure 13), is an annual herbaceous plant that is often cultivated in areas with altitudes 700 m above sea level in Indonesia, thriving on the island of Java and Sumatra (Damara et al., 2020).

Nutrients and Uses

The seeds of *P. sativum* are consumed as nutrition, appetizer, and astringent for their nutritional value, including protein (20-35%), fat (0.5-4%), starch (30-48%), fiber (it contributes positively to digestive health), and minerals (Castaldo et al., 2021). Due to its various nutritional contents, *P. sativum* can be processed into various food ingredients such as pea milk and plant-based or dairy-free yogurts (Wu et al., 2023).

Phytochemical and Bioactivity

Its seeds have various bioactive compounds, such as phenolic compounds (cinnamic acid, benzoic acid, gallic acid, ferulic acid, catechins, and hesperidin), which have pharmacological applications (Zia-Ul-Haq et al., 2013). Several studies reported the pharmacological activity of *P. sativum* such as hypoglycemic and antioxidant activities (Castaldo et al., 2021; Zilani et al., 2017).

Various studies of bioactive compounds of *P. sativum* extract have been widely analyzed (Table 1). β-sitosterol is a compound with antidiabetic properties, which stimulates basal glucose uptake, thereby maintaining glucose homeostasis through liver kinase B1 mediated by AMP-activated protein kinase (AMPK). The flavonoid compound, kaempferol, found in *P. sativum* seeds, can act as an antidiabetic by enhancing insulin-stimulated glucose uptake in adipose (fat) tissue. Since oxidative stress is a major cause of reduced glucose tolerance, antioxidants like kaempferol can serve as potential antihyperglycemic agents to improve this condition (Zilani et al., 2017). Additionally, β-sitosterol has antioxidant effects, serving as a hydrogen atom donor and breaking chain reactions due to free radicals (Alam & Khatun, 2016; Zilani et al., 2017).

In summary, the thirteen legume species reviewed in this study were found to have significant nutritional value as sources of carbohydrates, proteins, fats, and minerals. They also contain abundant phytochemicals, particularly phenolic and flavonoid compounds, which contribute to their diverse biological activities such as antioxidant, anti-inflammatory, antidiabetic, antihypertensive, antimicrobial, and anticancer effects.

CONCLUSION

In conclusion, this review successfully explored 13 legume species from the Legumonisae family found in Indonesia. Plants generally contain carbohydrates, proteins, starch, fats, and minerals, making them valuable as potential food sources. They also predominantly contain secondary metabolites, such as polyphenols and flavonoids (e.g., genistein, daidzein, cajanin), which have significant potential to be developed into pharmacologically active compounds.

ACKNOWLEDGMENT

The authors gratefully acknowledge the financial support from the University of Surabaya through the quality publication research scheme (Grant No. 022/SP-Lit/LPPM-01/Int/FF/V/2024).

CONFLICT OF INTEREST

There is no conflict of interest declared by the authors.

REFERENCES

Abu-Reidah, I. M., Arráez-Román, D., Lozano-Sánchez, J., Segura-Carretero, A., & Fernández-Gutiérrez, A. (2013). Phytochemical characterisation of green beans (*Phaseolus vulgaris* L.) by using high-performance liquid chromatography coupled with time of flight mass spectrometry. *Phytochemical Analysis, 24*(2), 105-116. https://doi.org/10.1002/pca.2385

Adama, K., Almamy, K., Isidore, G. B., Bernadette, Y., Amadou, T., Aziz, T. A., . . . Gaston, B. (2016). Seed germination and anthelmintic activity of *Cajanus cajan* on sheep. *Journal of Chemical and Pharmaceutical Research, 8*(1), 403-410

Ahmad, F., Anwar, F., & Hira, S. (2016). Review on medicinal importance of Fabaceae family. *Pharmacologyonline, 3*, 151-157

Ahmad, S., Kashif, M., Sattar, A., Qayyum, A., Sami, U.-A., Nawaz, A., & Manaf, A. (2019). Characterization of peanut (*Arachis hypogaea* L.) germplasm for morphological and quality traits in an arid environment. *Turkish Journal of Field Crops, 24*(2), 132-137. https://doi.org/10.17557/tjfc.615176

Ajaiyeoba, E., Ogbole, O., Abiodun, O., Ashidi, J., Houghton, P., & Wright, C. W. (2013). Cajachalcone: an antimalarial compound from *Cajanus cajan* leaf extract. *Journal of Parasitology Research, 2013*(1), 703781. https://doi.org/10.1155/2013/703781

Alam, A. K., & Khatun, C. S. (2016). Phytochemical analysis and antioxidant, analgesic and thrombolytic activity investigation of methanol extract of *Pisum sativum* seed. *Journal of Pharmacognosy and Phytochemistry, 5*(6), 366-370

Apriandini, L., Hanafi, M., Djamil, R., Desmiaty, Y., Lotulung, P. D. N., & Artanti, N. (2023). Antioxidant and Antidiabetic Compounds from Ebony Leaf Extract (*Diospyros celebica* Bakh.) and Their Correlation with Total Phenolic and Flavonoid Compounds in Various Solvent Extraction. *Journal of Natural Product for Degenerative Diseases, 1*(1), 8-18. https://doi.org/10.58511/jnpdd.v1i1.5454

Arifin, S. N., Pratiwi, D., & Setiawan, A. A. (2017). Studi *in silico* Senyawa Flavonoid dari Ekstrak Kacang Panjang (V*igna sinensis* L.) sebagai Penumbuh Rambut dengan Reseptor Androgen. *Jurnal Farmagazine, 4*(2), 31-37. http://dx.doi.org/10.47653/farm.v4i2.83

Arinanti, M. (2018). Potensi senyawa antioksidan alami pada berbagai jenis kacang. *Ilmu Gizi Indonesia, 1*(2), 134-143. https://doi.org/10.35842/ilgi.v1i2.7

Arise, A. K., Alashi, A. M., Nwachukwu, I. D., Ijabadeniyi, O. A., Aluko, R. E., & Amonsou, E. O. (2016). Antioxidant activities of bambara groundnut (*Vigna subterranea*) protein hydrolysates and their membrane ultrafiltration fractions. *Food & Function, 7*(5), 2431-2437. https://doi.org/10.1039/C6FO00057F

Arora, M., Singh, S., & Kaur, R. (2013). Phytochemical analysis, protein content & antimicrobial activities of selected samples of *Glycine max* Linn. *International Journal of Research in Engineering and Technology, 2*(11), 570-574

Baby, C., Kaur, S., Singh, J., & Prasad, R. (2023). Velvet bean (*Mucuna pruriens*): A sustainable protein source for tomorrow. *Legume Science, 5*(3), e178. https://doi.org/10.1002/leg3.178

Bak, S. G., Lim, H. J., Park, E. J., Won, Y. S., Lee, S. W., Lee, S., . . . Rho, M.-C. (2023). Effects of *Vigna angularis* extract and its active compound hemiphloin against atopic dermatitis-like skin inflammation. *Heliyon, 9*(2). https://doi.org/10.1016/j.heliyon.2023.e12994

Bria, E. J. (2017). Studi Karakter Morfologis Serbuk Sari Kacang Kratok (*Phaseolus lunatus* L.) menggunakan Scanning Electron Microscope sebagai Media Belajar Biologi SMA. *BIO-EDU: Jurnal Pendidikan Biologi, 2*(1), 1-2

Cahyani, D. N., Lestari, F., & Choesrina, R. (2015). Uji Aktivitas Antihiperglikemia Kombinasi Jus Kacang Panjang (*Vigna unguiculata* L. Walp) dan Jus Tomat (*Solanum lycopersicum* L.) pada Mencit Swiss Webster Jantan dengan Metode Induksi Aloksan. *Prosiding Farmasi*, 382-387

Camalxaman, S. N., Zain, Z. M., Amom, Z., Mustakim, M., Mohamed, E., & Rambely, A. S. (2013). *In vitro* antimicrobial activity of *Vigna radiata* (L) Wilzeck extracts against gram negative enteric bacteria. *World Applied Sciences Journal, 21*(10), 1490-1494. https://doi.org/10.5829/idosi.wasj.2013.21.10.2133

Cao, J. Q., Zhang, Y., Cui, J. M., & Zhao, Y. Q. (2011). Two new cucurbitane triterpenoids from *Momordica charantia* L. *Chinese Chemical Letters, 22*(5), 583-586. https://doi.org/10.1016/j.cclet.2010.11.033

Castaldo, L., Izzo, L., Gaspari, A., Lombardi, S., Rodríguez-Carrasco, Y., Narváez, A., . . . Ritieni, A. (2021). Chemical Composition of green pea (*Pisum sativum* L.) pods extracts and their potential exploitation as ingredients in nutraceutical formulations. *Antioxidants, 11*(1), 105. https://doi.org/10.3390/antiox11010105

Chalid, S. Y., Muawanah, A., Nurbayti, S., & Utami, W. M. (2021). *Characteristics and antioxidant activity of kidney bean (Phaseolus vulgaris L.) tempeh as functional food.* Paper presented at the AIP Conference Proceedings. https://doi.org/10.1063/5.0041748

Chen, X., Lu, Q., Liu, H., Zhang, J., Hong, Y., Lan, H., . . . Li, S. (2019). Sequencing of cultivated peanut, *Arachis hypogaea*, yields insights into genome evolution and oil improvement. *Molecular Plant, 12*(7), 920-934. https://doi.org/10.1016/j.molp.2019.03.005

Chinapolaiah, A., Manjesh, G., Thondaiman, V., & Rao, V. K. (2019). Variability in L-Dopa and other biochemical composition of *Mucuna pruriens* (L.) an underutilized tropical legume. *Industrial Crops and Products, 138*, 111447. https://doi.org/10.1016/j.indcrop.2019.06.010

Chinnapun, D., & Sakorn, N. (2022). Structural characterization and antioxidant and anti-inflammatory activities of new chemical constituent from the seeds of bambara groundnut (*Vigna subterranea* (L.) Verdc.). *CyTA-Journal of Food, 20*(1), 93-101. https://doi.org/10.1080/19476337.2022.2087741

Choi, H., Park, J.-S., Kim, K.-M., Kim, M., Ko, K.-W., Hyun, C.-G., . . . Kim, S.-Y. (2018). Enhancing the antimicrobial effect of genistein by biotransformation in microbial system. *Journal of Industrial and Engineering Chemistry, 63*, 255-261. https://doi.org/10.1016/j.jiec.2018.02.023

Ciau-Solís, N. A., Acevedo-Fernández, J. J., & Betancur-Ancona, D. (2018). *In vitro* renin–angiotensin system inhibition and *in vivo* antihypertensive activity of peptide fractions from lima bean (*Phaseolus lunatus* L.). *Journal of the Science of Food and Agriculture, 98*(2), 781-786. https://doi.org/10.1002/jsfa.8543

Dahiya, P., Linnemann, A., Van Boekel, M., Khetarpaul, N., Grewal, R., & Nout, M. (2015). Mung bean: Technological and nutritional potential. *Critical Reviews in Food Science and Nutrition, 55*(5), 670-688. https://doi.org/10.1080/10408398.2012.671202

Damara, H. L., Santika, I. W., & Waluyo, B. (2020). Keragaman dan Korelasi Karakteristik Fisik Biji dengan Perkecambahan dan Karakter Hasil pada Kacang Ercis (*Pisum sativum* L.). *Plantropica: Journal of Agricultural Science, 5*(1), 74-84. https://doi.org/10.21776/ub.jpt.2020.005.1.9

Devade, O., Mehta, S. A., Lohare, S. B., Tawakale, R. S., & Jadhav, D. Y. (2022). Assessment of Anthelmintic Activity of *Pisum sativum*. *International Journal of Pharmaceutical Sciences and Research, 12*(2), 7-12

Diniyah, N., & Lee, S.-H. (2020). Komposisi senyawa fenol dan potensi antioksidan dari kacang-kacangan. *Jurnal Agroteknologi, 14*(01), 91-102

Doss, A., Pugalenthi, M., & Vadivel, V. (2011). Antioxidant activity of raw and differentially processed under-utilized tropical legume *Canavalia ensiformis* L. DC seeds, South India. *The IIOAB Journal, 2*(8), 27-32

Ezeagu, I. E., & Ibegbu, M. D. (2010). Biochemical composition and nutritional potential of ukpa: a variety of tropical lima beans (*Phaseolus lunatus*) from Nigeria-a short report. *Polish Journal of Food and Nutrition Sciences, 60*(3), 44-51. https://doi.org/10.24831/jai.v48i1.27597

Fadillah, R., & Purnamawati, H. (2020). Produksi Kacang Tunggak (*Vigna unguiculata* [L.] Walp) dengan Input Pupuk Rendah. *Indonesian Journal of Agronomy, 48*(1), 44-51

Firdousi, S., Chakraborty, R., & Roy, S. (2021). Nutritional and Antioxidant Properties of the Seeds of *Vigna unguiculata* subsp. sesquipedalis (L.) Verdc.–An Underutilized Legume of West Bengal. *NBU Journal of Plant Sciences, 13*, 27-41. https://doi.org/10.55734/NBUJPS.2021.v13i01.004

Fuller, D. Q., Murphy, C., Kingwell-Banham, E., Castillo, C. C., & Naik, S. (2019). *Cajanus cajan* (L.) Millsp. origins and domestication: the South and Southeast Asian archaeobotanical evidence. *Genetic Resources and Crop Evolution, 66*(6), 1175-1188. https://doi.org/10.1007/s10722-019-00774-w

Ganesan, K., & Xu, B. (2018). A critical review on phytochemical profile and health promoting effects of mung bean (*Vigna radiata*). *Food Science and Human Wellness, 7*(1), 11-33. https://doi.org/10.1016/j.fshw.2017.11.002

Gargi, B., Semwal, P., Jameel Pasha, S. B., Singh, P., Painuli, S., Thapliyal, A., & Cruz-Martins, N. (2022). Revisiting the Nutritional, Chemical and Biological Potential of *Cajanus cajan* (L.) Millsp. *Molecules, 27*(20), 6877. https://doi.org/10.3390/molecules27206877

Gul, A., Khan, H., Shah, S. I., Alsharif, K. F., Qahl, S. H., Rehman, I. U., . . . Ming, L. C. (2023). Pharmaceutical development of intraperitoneal *Arachis hypogaea* as a renal protective agent. *Frontiers in Bioscience-Landmark, 28*(1), 14. https://doi.org/10.31083/j.fbl2801014

Han, D.-G., Bae, M.-J., & An, B.-J. (2022). Anti-Inflammatory Activity of Velvet Bean (*Mucuna pruriens*) Substances in LPS− Stimulated RAW 264.7 Macrophages. *Molecules, 27*(24), 8797. https://doi.org/10.3390/molecules27248797

Haq, S. K., & Khan, R. H. (2003). Characterization of a proteinase inhibitor from *Cajanus cajan* (L.). *Journal of Protein Chemistry, 22*, 543-554. https://doi.org/10.1023/B:JOPC.0000005504.57372.5b

Harmayetty, I. K., & Anisa, F. (2015). Jus Kacang Panjang (*Vigna sinensis* L.) menurunkan Kadar Glukosa Darah Pasien Diabetes Mellitus. *Jurnal Ners, 4*(2), 116-121

Hasan, M. M., Cha, M., Bajpai, V. K., & Baek, K.-H. (2013). Production of a major stilbene phytoalexin, resveratrol in peanut (*Arachis hypogaea*) and peanut products: a mini review. *Reviews in Environmental Science and Bio/Technology, 12*, 209-221. https://doi.org/10.1007/s11157-012-9294-7

Heuzé, V., Tran, G., & Lebas, F. (2020). Bambara groundnut (*Vigna subterranea*) haulms. Feedipedia, a programme by INRAE, CIRAD, AFZ and FAO. https://feedipedia.org/node/531.

Hou, D., Yousaf, L., Xue, Y., Hu, J., Wu, J., Hu, X., . . . Shen, Q. (2019). Mung bean (*Vigna radiata* L.): Bioactive polyphenols, polysaccharides, peptides, and health benefits. *Nutrients, 11*(6), 1238. https://doi.org/10.3390/nu11061238

Ivantirta, I. (2019). Efek Antihiperglikemi Kacang Panjang (*Vigna unguiculata*). *Jurnal Ilmiah Kesehatan Sandi Husada, 8*(2), 359-362. https://doi.org/10.35816/jiskh.v10i2.191

Jannah, A. R., Ebnudesita, F. R., Dienanta, S. B., &

I'tishom, R. (2020). The potential of soy isoflavones (*Glycine max*) and magnetic hydroxyapatite nanoparticles as osteoporosis therapy for menopausal women. *Indonesian Andrology and Biomedical Journal, 1*(1), 27-35. https://doi.org/10.20473/iabj.v1i1.29

Jeong, E.-W., Park, S.-Y., Yang, Y.-S., Baek, Y.-J., Yun, D.-M., Kim, H.-J., . . . Lee, H.-G. (2021). Black soybean and adzuki bean extracts lower blood pressure by modulating the renin-angiotensin system in spontaneously hypertensive rats. *Foods, 10*(7), 1571. https://doi.org/10.3390/foods10071571

Jiang, S., Ma, Y., & Yan, D. (2014). Antioxidant and antimicrobial properties of water soluble polysaccharide from *Arachis hypogaea* seeds. *Journal of Food Science and Technology, 51*, 2839-2844. https://doi.org/10.1007/s13197-012-0786-9

Johnson, J. B., Neupane, P., Bhattarai, S. P., Trotter, T., & Naiker, M. (2023). Phenolic profiles and acetylcholinesterase inhibitory activity in Australian adzuki bean. *Food Chemistry Advances, 3*, 100361. https://doi.org/10.1016/j.focha.2023.100361

Kan, L., Nie, S., Hu, J., Wang, S., Cui, S. W., Li, Y., . . . Bai, Z. (2017). Nutrients, phytochemicals and antioxidant activities of 26 kidney bean cultivars. *Food and Chemical Toxicology, 108*, 467-477. https://doi.org/10.1016/j.fct.2016.09.007

Karri, V. R., & Nalluri, N. (2017). Pigeon pea (*Cajanus cajan* L.) by-products as potent natural resource to produce protein rich edible food products. *International Journal of Current Agricultural Sciences, 7*(07), 229-236

Kaswinarni, F., Suharno, B., & Winarta, O. (2014). Berbagai Fenomena Kacang Panjang (*Vigna sinensis*) terhadap Penambahan Kompos Organik Pada Pemupukan Batuan Fosfat. *Bioma: Jurnal Ilmiah Biologi, 3*(1), 16-26. https://doi.org/10.26877/bioma.v3i1,%20April.647

Khanum, R., Mazhar, F., & Jahangir, M. (2015). Antioxidant evaluations of polar and non-polar fractions of *Cajanus cajan* seeds. *Journal of Medicinal Plants Research, 9*(6), 193-198. https://doi.org/10.5897/JMPR2014.5456

Kotkar, A., Bhangale, D. C. J., Aher Vandana, P., & Vaditke, K. (2020). A study on Anthelmintic Activity of *Canavalia ensiformis* (Jack bean) Pods. *International Journal of Innovative Science and Research Technology, 5*(10), 798-802

Lampariello, L. R., Cortelazzo, A., Guerranti, R., Sticozzi, C., & Valacchi, G. (2012). The magic velvet bean of *Mucuna pruriens*. *Journal of Traditional and Complementary Medicine, 2*(4), 331-339. https://doi.org/10.1016/S2225-4110(16)30119-5

Liu, R., Zheng, Y., Cai, Z., & Xu, B. (2017). Saponins and flavonoids from adzuki bean (*Vigna angularis* L.) ameliorate high-fat diet-induced obesity in ICR mice. *Frontiers in Pharmacology, 8*, 687. https://doi.org/10.3389/fphar.2017.00687

Liu, W., Ma, H., DaSilva, N. A., Rose, K. N., Johnson, S. L., Zhang, L., . . . Seeram, N. P. (2016). Development of a neuroprotective potential algorithm for medicinal plants. *Neurochemistry International, 100*, 164-177. https://doi.org/10.1016/j.neuint.2016.09.014

Mahardhika, B. P., Ridla, M., Mutia, R., Febriani, S., & Purbaya, A. M. (2023). The evaluation of the use of jack bean (*Canavalia ensiformis*) and protease enzyme on the broiler diet with the different level of protein. *Livestock and Animal Research, 21*(2), 69-79. https://doi.org/10.20961/lar.v21i2.63459

Malenčić, D., Popović, M., & Miladinović, J. (2007). Phenolic content and antioxidant properties of soybean (*Glycine max* (L.) Merr.) seeds. *Molecules, 12*(3), 576-581. https://doi.org/10.3390/12030576

Miftahul, S., & Sopandi, T. (2016). Pemanfaatan kacang tunggak (*Vigna unguiculata*) ditambah air siwalan (*Borassus flabellifer*) sebagai bahan baku pembuatan kecap. *STIGMA: Jurnal Matematika dan Ilmu Pengetahuan Alam Unipa, 9*(01), 19-25. https://doi.org/10.36456/stigma.vol9.no01.a328

Mingrou, L., Guo, S., Ho, C.-T., & Bai, N. (2022). Review on chemical compositions and biological activities of peanut (*Arachis hypogeae* L.). *Journal of Food Biochemistry, 46*(7), e14119. https://doi.org/10.1111/jfbc.14119

Modgil, R., Tanwar, B., Goyal, A., & Kumar, V. (2021). Soybean (*Glycine max*). In B. Tanwar & A. Goyal (Eds.), *Oilseeds: Health Attributes and Food Applications* (pp. 1-46). Singapore: Springer.

Mohammed, M., Shimelis, H., & Laing, M. (2016). Preliminary investigation on some agronomic and morphological variations of within and between bambara groundnut landraces. *Journal of Agricultural Science and Technology, 18*, 1909-1920

Muawanah, A., Chalid, S., Hatiningsih, F., Nurbayti, S., & Zunaedi, Z. (2022). *Angiotensin Converting Enzyme (ACE) Inhibitory Activity and Extract Protein Profiles* *of Mung Beans (Vigna radiata L.) Tempeh which Fermented by Rhizopus sp.* Paper presented at the IOP Conference Series: Earth and Environmental Science. http://dx.doi.org/10.1088/1755-1315/995/1/012048

Mulyani, L., Kartadarma, E., & Fitrianingsih, S. P. (2016). Manfaat dan kandungan kacang kara benguk (*Mucuna pruriens* L.) sebagai obat herbal. *Prosiding Farmasi, 2*(2), 351-357. http://dx.doi.org/10.29313/.v0i0.4293

Munip, A. (2009). *Potensi Kratok (Phaseolus lunatus Linn.) dalam Tinjauan Bioetika Pangan dan Industri.* Paper presented at the Prosiding Seminar Nasional Bioetika Pertanian

Murthy, S., Nirawane, R., Gurav, A., Mhase, A., Sangvikar, S., Rao, G., & Kulkarni, Y. (2016). Comparative pharmacognostical evaluation of seeds of *Mucuna cochinchinensis* (Lour.) A. Chev. (black and white varieties) with *M. pruriens* (L.) DC. *Global Journal of Research on Medicinal Plants & Indigenous Medicine, 5*(3), 79-91

Nassar, R. M., Ahmed, Y. M., & Boghdady, M. S. (2010). Botanical studies on *Phaseolus vulgaris* L. I-morphology of vegetative and reproductive growth. *International Journal of Botany, 6*(3), 323-333. https://doi.org/10.3923/ijb.2010.323.333

Ngawi, D. K. P. d. P. K. (2023). Klasifikasi Kedelai, Tanaman Segudang Manfaat. Access by https://pertanian.ngawikab.go.id/.

Ningsih, F., Zubaidah, S., & Kuswantoro, H. (2019). *Diverse morphological characteristics of soybean (Glycine max L. Merill) pods and seeds germplasm.* Paper presented at the IOP Conference Series: Earth and Environmental Science. http://dx.doi.org/10.1088/1755-1315/276/1/012014

Nugrahani, R., Andayani, Y., & Hakim, A. (2020). Antioxidant activity of fruit extract powder beans (*Phaseolus vulgaris* L.) using DPPH method. *Jurnal Penelitian Pendidikan IPA, 6*(2), 194-198. https://doi.org/10.29303/jppipa.v6i2.409

Nyandwaro, K., Oyweri, J., Kimani, F., & Mbugua, A. (2020). Evaluating antiplasmodial and antimalarial activities of soybean (*Glycine max*) seed extracts on *P. falciparum* parasite cultures and *P. berghei*-infected mice. *Journal of Pathogens, 2020*. https://doi.org/10.1155/2020/7605730

Nyau, V., Prakash, S., Rodrigues, J., & Farrant, J. (2015). Antioxidant activities of Bambara groundnuts as assessed by FRAP and DPPH assays. *American Journal of Food and Nutrition, 3*(1), 7-11. https://doi.org/10.12691/ajfn-3-1-2

Olaseeni, J. A., Rrmi, O., & Alademeyin, J. O. (2023). Quality evaluation and antimicrobial activities of adzuki bean seed oil (*Vigina angularis*). *International Journal of Chemical Science, 7*(1), 50-52

Palupi, H., Estiasih, T., & Yunianta, S. A. (2022). Physicochemical and protein characterization of lima bean (*Phaseolus lunatus* L) seed. *Food Research, 6*, 168-177

Pandiyan, M., Sivakumar, P., Krishnaveni, A., Sivakumar, C., Radhakrishnan, V., Vaithiyalingam, M., & Tomooka, N. (2021). Adzuki bean *The Beans and the Peas* (pp. 89-103): Elsevier.

Park, S. H., Do, M. H., Lee, J. H., Jeong, M., Lim, O. K., & Kim, S. Y. (2017). Inhibitory effect of *Arachis hypogaea* (Peanut) and its phenolics against methylglyoxal-derived advanced glycation end product toxicity. *Nutrients, 9*(11), 1214. https://doi.org/10.3390/nu9111214

Pathania, R., Chawla, P., Khan, H., Kaushik, R., & Khan, M. A. (2020). An assessment of potential nutritive and medicinal properties of *Mucuna pruriens*: a natural food legume. *3 Biotech, 10*(6), 261. https://doi.org/10.1007/s13205-020-02253-x

Pavek, P. L. S. (2012). Plant guide for pea (*Pisum sativum* L.). USDA-Natural Resources Conservation Service, Pullman, WA. Access link:https://plants.usda.gov/.

Prasad, P., Kakani, V., & Upadhyaya, H. (2010). Growth and Production of Groundnuts. In W. Verheye (Ed.), *Soils, Plant Growth and Crop Production* (Vol. Volume II, pp. 153). Singapore: EOLSS Publishers.

Puspitojati, E., Cahyanto, M. N., Marsono, Y., & Indrati, R. (2023). Jack Bean (*Canavalia ensiformis*) Tempeh: ACE-Inhibitory Peptide Formation during Absorption in the Small Intestine. *Food Technology and Biotechnology, 61*(1), 64-72. https://doi.org/10.17113/ftb.61.01.23.7635

Putri, J. Y., Nastiti, K., & Hidayah, N. (2023). Pengaruh Pelarut Etanol 70% Dan Metanol Terhadap Kadar Flavonoid Total Ekstrak Daun Sirsak (*Annona muricata* Linn). *Journal Pharmaceutical Care and Sciences, 3*(2), 20-29. https://doi.org/10.33859/jpcs.v3i2.235

Putri, S. W. K., Nurhasana, D., Avidlyandi, A., Gustian, I., Sipriyadi, S., & Adfa, M. (2021). Aktivitas Antibakteri Ekstrak Etanol Daun Tapak Kuda (*Ipomoea* *pes-caprae* (L.) R. Br.) Terhadap Bakteri *Staphylococcus epidermidis*. *BIOEDUSAINS: Jurnal Pendidikan Biologi dan Sains, 4*(2), 355-362. https://doi.org/10.31539/bioedusains.v4i2.2864

Puzserova, A., & Bernatova, I. (2016). Blood pressure regulation in stress: focus on nitric oxide-dependent mechanisms. *Physiological Research, 65*(Suppl 3), S309-S342. https://doi.org/10.33549/physiolres.933442

Quamruzzaman, A., Islam, F., Akter, L., Khatun, A., Mallick, S. R., Gaber, A., . . . Hossain, A. (2022). Evaluation of the quality of yard-long bean (*Vigna unguiculata* subsp. *sesquipedalis* L.) Cultivars to Meet the Nutritional Security of Increasing Population. *Agronomy, 12*(9), 2195. https://doi.org/10.3390/agronomy12092195

Rahmah, S., & Setiawan, S. (2023). Analisis Kekerabatan Tanaman Famili Fabaceae Berdasarkan Karakteristik Morfologi di Kecamatan Jatinangor, Kabupaten Sumedang. *Konstanta: Jurnal Matematika dan Ilmu Pengetahuan Alam, 1*(2), 162-171. https://doi.org/10.59581/konstanta-widyakarya.v1i2.814

Ramatsetse, K. E., Ramashia, S. E., & Mashau, M. E. (2023). A review on health benefits, antimicrobial and antioxidant properties of Bambara groundnut (*Vigna subterranean*). *International Journal of Food Properties, 26*(1), 91-107. https://doi.org/10.1080/10942912.2022.2153864

Rocha, T. L., Soll, C. B., Boughton, B. A., Silva, T. S., Oldach, K., Firmino, A. A., . . . Carneiro, R. M. (2017). Prospection and identification of nematotoxic compounds from *Canavalia ensiformis* seeds effective in the control of the root knot nematode *Meloidogyne incognita*. *Biotechnology Research and Innovation, 1*(1), 87-100. https://doi.org/10.1016/j.biori.2017.10.003

Rodríguez, L., Mendez, D., Montecino, H., Carrasco, B., Arevalo, B., Palomo, I., & Fuentes, E. (2022). Role of *Phaseolus vulgaris* L. in the prevention of cardiovascular diseases—cardioprotective potential of bioactive compounds. *Plants, 11*(2), 186. https://doi.org/10.3390/plants11020186

Rungruangmaitree, R., & Jiraungkoorskul, W. (2017). Pea, *Pisum sativum*, and its anticancer activity. *Pharmacognosy Reviews, 11*(21), 39-42. https://doi.org/10.4103/phrev.phrev_57_16

Saad, A. M., Sitohy, M. Z., Ahmed, A. I., Rabie, N. A., Amin, S. A., Aboelenin, S. M., . . . El-Saadony, M. T. (2021). Biochemical and functional characterization of kidney bean protein alcalase-hydrolysates and their preservative action on stored chicken meat. *Molecules, 26*(15), 4690. https://doi.org/10.3390/molecules26154690

Samosir, O. M., Marpaung, R. G., & Laia, T. (2020). Respon kacang tanah (*Arachis hypogaea* L) terhadap pemberian unsur mikro. *Jurnal Agrotekda, 3*(2), 74-83

Sandeep, D. (2014). Evaluation of antibacterial activity of seed extracts of *Vigna unguiculata*. *International Journal of Pharmacy and Pharmaceutical Sciences, 6*(1), 75-77

Sardjono, R., Khoerunnisa, F., Musthopa, I., Akasum, N., & Rachmawati, R. (2018). *Synthesize, characterization, and anti-Parkinson activity of silver-Indonesian velvet beans (Mucuna pruriens) seed extract nanoparticles (AgMPn).* Paper presented at the Journal of Physics: Conference Series. http://dx.doi.org/10.1088/1742-6596/1013/1/012195

Sasnia, W. N., Yuliawati, Y., Rahayu, A., & Setyono, S. (2021). Karakter Morfologi dan Hubungan Kekerabatan Galur-galur Kacang Bogor (*Vigna subterranea* L. Verdc.) Asal Lanras Sukabumi. *Jurnal Agronida, 7*(1), 26-35. https://doi.org/10.30997/jag.v7i1.4141

Sayekti, R. S., & Djoko Prajitno, T. (2012). Karakterisasi Delapan Aksesi Kacang Tunggak (*Vigna unguiculata* {L.} Walp) Asal Daerah Istimewa Yogyakarta. *Vegetalika, 1*(1), 1-10. https://doi.org/10.22146/veg.1379

Sebei, K., Gnouma, A., Herchi, W., Sakouhi, F., & Boukhchina, S. (2013). Lipids, proteins, phenolic composition, antioxidant and antibacterial activities of seeds of peanuts (*Arachis hypogaea* l) cultivated in Tunisia. *Biological Research, 46*(3), 257-263. http://dx.doi.org/10.4067/S0716-97602013000300006

Sefrila, M., Ghulamahdi, M., Purwono, P., Melati, M., & Mansur, I. (2023). Growth and production of soybean on different inoculant sources of arbuscular mycorrhizal fungi and water saturation periods. *Indonesian Journal of Agronomy, 51*(1), 45-53. http://dx.doi.org/10.24831/ija.v51i1.46041

Shamsi, T. N., Parveen, R., Afreen, S., Azam, M., Sen, P., Sharma, Y., . . . Fatima, S. (2018). Trypsin inhibitors from *Cajanus cajan* and *Phaseolus limensis* possess antioxidant, anti-inflammatory, and antibacterial activity. *Journal of Dietary Supplements, 15*(6), 939-950. https://doi.org/10.1080/19390211.2017.1407383

Shamsi, T. N., Parveen, R., Ahamad, S., & Fatima, S. (2017). Structural and biophysical characterization of *Cajanus cajan* protease inhibitor. *Journal of Natural*

Science, Biology, and Medicine, 8(2), 186. https://doi.org/10.4103/0976-9668.210018

Sharma, P., Gupta, S., Bhatt, N., Ahanger, S., Gupta, D., Singh, P., . . . Bhagat, M. (2019). Antioxidant and phytochemical analysis of volatile oil and extracts of *Pinus wallichiana*. *MOJ Biology and Medicine, 4*(2), 37-40. https://doi.org/10.15406/mojbm.2019.04.00111

Sheahan, C. (2012). Plant guide for jack bean (*Canavalia ensiformis*). *USDA Natural Resources Conservation Service: Washington, DC, USA, 4*

Sheahan, C. M. (2012). Plant guide for cowpea (*Vigna unguiculata*). USDA-Natural Resources Conservation Service, Cape May Plant Materials Center, Cape May, NJ. .

Siddhuraju, P., & Becker, K. (2007). The antioxidant and free radical scavenging activities of processed cowpea (*Vigna unguiculata* (L.) Walp.) seed extracts. *Food Chemistry, 101*(1), 10-19. https://doi.org/10.1016/j.foodchem.2006.01.004

Simarmata, T. I. (2023). Potensi Kacang Lentil Sebagai Produk Pangan Fungsional. *Jurnal Ilmiah Wahana Pendidikan, 9*(17), 639-641. https://doi.org/10.5281/zenodo.8321299

Singh, A., Raina, S. N., Sharma, M., Chaudhary, M., Sharma, S., & Rajpal, V. R. (2021). Functional uses of peanut (*Arachis hypogaea* L.) seed storage proteins. In J. C. Jimenez-Lopez (Ed.), *Grain and seed proteins functionality* (pp. 121-142). London: IntechOpen.

Singh, B., Singh, J. P., Kaur, A., & Singh, N. (2017). Phenolic composition and antioxidant potential of grain legume seeds: A review. *Food Research International, 101*, 1-16. https://doi.org/10.1016/j.foodres.2017.09.026

Somdee, T., Mahaweerawat, U., Wibulutai, J., Dungkokruad, N., & Yungyuen, S. (2017). Polyphenol contents, antioxidant and anticancer activity (MCF-7) of soybean products in Thailand. *Chiang Mai Journal of Science, 44*, 176-183

Sonklin, C., Alashi, M. A., Laohakunjit, N., Kerdchoechuen, O., & Aluko, R. E. (2020). Identification of antihypertensive peptides from mung bean protein hydrolysate and their effects in spontaneously hypertensive rats. *Journal of Functional Foods, 64*, 103635. https://doi.org/10.1016/j.jff.2019.103635

Sood, S., & Gupta, N. (2017). Lima bean. In M. Rana (Ed.), *Vegetable Crop Science* (pp. 701-714). Boca Raton: CRC Press.

Spanou, C., Stagos, D., Aligiannis, N., & Kouretas, D. (2010). Influence of potent antioxidant leguminosae family plant extracts on growth and antioxidant defense system of Hep2 cancer cell line. *Journal of Medicinal Food, 13*(1), 149-155.

Suhaema, S., & Widiada, I. G. N. (2023). Hypoglycemic Effect Pigeon Pea (*Cajanus cajan*) in Diabetes Mellitus. *Jurnal Gizi Prima (Prime Nutrition Journal), 8*(1), 1-6. https://doi.org/10.32807/jgp.v8i1.394

Sumarny, R., Musir, A., & Ningrum. (2013). *Penapisan Fitokimia dan Uji Efek Hipoglikemik Ekstrak Kacang Panjang (Vigna unguiculata Subsp. unguiculata L.) dan Ekstrak Tauge (Vigna radiata L.) pada Mencit yang Dibebani Glukosa Secara Oral.*

Surahman, Y. (2023). Pertumbuhan dan Hasil Delapan Aksesi Kacang Bogor (*Vigna subterranea* L. Verdc.) Asal Bogor dan Sukabumi. *Jurnal Agronida, 9*(2), 103–112. https://doi.org/10.30997/jag.v9i2.10881

Sutedja, A. M., Yanase, E., Batubara, I., Fardiaz, D., & Lioe, H. N. (2020). Identification and characterization of α-glucosidase inhibition flavonol glycosides from jack bean (*Canavalia ensiformis* (L.) DC). *Molecules, 25*(11), 2481. https://doi.org/10.3390/molecules25112481

Sutjaritjai, N., Wangpakapattanawong, P., Balslev, H., & Inta, A. (2019). Traditional uses of Leguminosae among the Karen in Thailand. *Plants, 8*(12), 600. https://doi.org/10.3390/plants8120600

Tamayo, J., Poveda, T., Paredes, M., Vásquez, G., & Calero-Caceres, W. (2018). Antimicrobial, Antioxidant and Anti-Inflammatory Activities of Proteins of *Phaseoulus lunatus* (Fabaceae) Baby Lima Beans Produced in Ecuador. *bioRxiv*, 401323. https://doi.org/10.1101/401323

Tang, D., Dong, Y., Ren, H., Li, L., & He, C. (2014). A review of phytochemistry, metabolite changes, and medicinal uses of the common food mung bean and its sprouts (*Vigna radiata*). *Chemistry Central Journal, 8*, 1-9. https://doi.org/10.1186/1752-153X-8-4

Tristantini, D., Ismawati, A., Pradana, B. T., & Jonathan, J. G. (2016). *Pengujian aktivitas antioksidan menggunakan metode DPPH pada daun tanjung (Mimusops elengi L.).* Paper presented at the Seminar Nasional Teknik Kimia" Kejuangan"

Tungmunnithum, D., Drouet, S., Lorenzo, J. M., & Hano, C. (2021). Green Extraction of antioxidant flavonoids from pigeon pea (*Cajanus cajan* (L.) Millsp.) seeds and its antioxidant potentials using ultrasoundassisted methodology. *Molecules, 26*(24), 7557. https://doi.org/10.3390/molecules26247557

Tungmunnithum, D., & Hano, C. (2020). Cosmetic potential of *Cajanus cajan* (L.) millsp: Botanical data, traditional uses, phytochemistry and biological activities. *Cosmetics, 7*(4), 84. https://doi.org/10.3390/cosmetics7040084

Tušar, L., Usenik, A., Turk, B., & Turk, D. (2021). Mechanisms applied by protein inhibitors to inhibit cysteine proteases. *International Journal of Molecular Sciences, 22*(3), 997. https://doi.org/10.3390/ijms22030997

Udeh, E. L., Nyila, M. A., & Kanu, S. A. (2020). Nutraceutical and antimicrobial potentials of Bambara groundnut (*Vigna subterranean*): A review. *Heliyon, 6*(10). https://doi.org/10.1016/j.heliyon.2020.e05205

Umami, N., Dewi, M. P., Andru, A., Astuti, D., Sayekti, R. T., & Taryono, T. (2019). Potensi beberapa asesi kacang panjang (*Vigna unguiculata ssp. sesquipedalis*) sebagai pakan di Indonesia. *Pastura: Journal of Tropical Forage Science, 9*(1), 18-20

Utami, R., Widowati, E., & Purwandari, Y. W. (2015). Karakteristik Kaldu Nabati Kedelai Hitam (*Glycine soja*), Kacang Gude (*Cajanus cajan*, Mills) dan Biji Saga (*Adenanthera pavonina*, Linn) Melalui Fermentasi Koji Moromi. *Jurnal Teknologi Hasil Pertanian, 8*(1), 30-36. https://doi.org/10.20961/jthp.v0i0.12792

Ventosa, F. E. A. (2022). *Canavalia ensiformis* (jack bean). *CABI Compendium*. 10.1079/cabicompendium.14486

Wang, Y., Yao, X., Shen, H., Zhao, R., Li, Z., Shen, X., . . . Li, B. (2022). Nutritional composition, efficacy, and processing of *Vigna angularis* (Adzuki bean) for the human diet: An overview. *Molecules, 27*(18), 6079. https://doi.org/10.3390/molecules27186079

Widiantara, T., & Cahyadi, W. (2018). Pemanfaatan kacang koro pedang (*Canavalia ensiformis* L.) terhadap pembuatan tahu kacang koro berdasarkan perbedaan konsentrasi koagulan. *Pasundan Food Technology Journal (PFTJ), 4*(3), 182-190. https://doi.org/10.23969/pftj.v4i3.644

Winarni, S., Judiwati, R., Prajogo, B., & Hayati, A. (2011). Fraksi etanol 96% biji koro benguk (*Mucuna pruriens* L.) sebagai peningkat kualitas spermatozoa mencit (*Mus musculus*). *Jurnal Kesehatan Reproduksi, 1*(2), 60-66

Wu, D.-T., Li, W.-X., Wan, J.-J., Hu, Y.-C., Gan, R.-Y., & Zou, L. (2023). A comprehensive review of pea (*Pisum sativum* L.): chemical composition, processing, health benefits, and food applications. *Foods, 12*(13), 2527. https://doi.org/10.3390/foods12132527

Wulandari, Y. A., Sobir, S., & Aisyah, S. I. (2020). Analisis Keragaman dan Kekerabatan Kacang Tunggak *Vigna unguiculata* L. *Jurnal Agrosains dan Teknologi, 5*(1), 46-56. https://doi.org/10.24853/jat.5.1.46-56

Xu, B., & Chang, S. K. (2008). Effect of soaking, boiling, and steaming on total phenolic content and antioxidant activities of cool season food legumes. *Food Chemistry, 110*(1), 1-13. https://doi.org/10.1016/j.foodchem.2008.01.045

Yi-Shen, Z., Shuai, S., & FitzGerald, R. (2018). Mung bean proteins and peptides: Nutritional, functional and bioactive properties. *Food & Nutrition Research, 62*, 1290. https://doi.org/10.29219/fnr.v62.1290

Yuliani, S. H., Istyastono, E. P., & Riswanto, F. D. O. (2016). The cytotoxic activity on T47D breast cancer cell of genistein-standardized ethanolic extract of tempeh-A fermented product of soybean (*Glycine max*). *Oriental Journal of Chemistry, 32*(3), 1619-1624. http://dx.doi.org/10.13005/ojc/320338

Yusuf, D., Kholifaturrohmah, R., Nurcholis, M., Setiarto, R. H. B., & Anggadhania, L. (2023). Potential of White Jack Bean (*Canavalia ensiformis* L. DC) Kefir as a microencapsulated antioxidant. *Preventive Nutrition and Food Science, 28*(4), 453-462. https://doi.org/10.3746/pnf.2023.28.4.453

Zaevi, B., Napitupulu, M., & Astuti, P. (2014). Respon tanaman kacang panjang (*Vigna sinensis* L.) terhadap pemberian pupuk NPK pelangi dan pupuk organik cair Nasa. *Agrifor: Jurnal Ilmu Pertanian dan Kehutanan, 13*(1), 19-32. https://doi.org/10.31293/af.v13i1.544

Zia-Ul-Haq, M., Amarowicz, R., Ahmad, S., & Riaz, M. (2013). Antioxidant potential of some pea (*Pisum sativum* L.) cultivars commonly consumed in Pakistan. *Oxid Commun, 36*(4), 1046-1057

Zilani, M. N. H., Sultana, T., Asabur Rahman, S., Anisuzzman, M., Islam, M. A., Shilpi, J. A., & Hossain, M. G. (2017). Chemical composition and pharmacological activities of *Pisum sativum*. *BMC Complementary and Alternative Medicine, 17*, 171. https://doi.org/10.1186/s12906-017-1699-y

Zillich, O., Schweiggert-Weisz, U., Eisner, P., & Kerscher, M. (2015). Polyphenols as active ingredients for cosmetic products. *International Journal of Cosmetic Science, 37*(5), 455-464. https://doi.org/10.1111/ics.12218