Nutritional value, Ethnomedicine, Phytochemistry and pharmacology of Vigna radiata (L.) R. Wilczek

Anum Kalim, Mehreen Zaheer, Maaz Uddin Ahmed Siddiqui, Salman Ahmed and Muhammad Mohtasheemul Hassan

DOI: https://doi.org/10.22271/phyto.2021.v10.i2a.13821

Abstract
Vigna radiata (L.) R. Wilczek commonly known as Mung bean is one of the most important pulse crops, grown from tropical to sub-tropical areas around the world. Mung bean is reported to help in preventing the loss of nails and hairs, and also reduces the risk of hypercholesterolemia, coronary heart disease and decreases the absorption of toxic substances. Flavonoids and phenols are reported from this plant. Antioxidant, antidiabetic and hypocholesterolemic activities are also shown by Vigna radiata.

Keywords: Vigna radiata, Ethnomedicine, Phytochemistry, pharmacology

Introduction
Vigna radiata (L.) R. Wilczek, commonly known as Mung bean is widely grown in south and south-east Asia. More than 80% of the Mung bean is produced in South Asia [1]. Vigna radiata is one of the most important pulse crops, grown from tropical to sub-tropical areas around the world [2].

The sprouts and seeds of Mung beans are used as fresh salad vegetable or common food in Bangladesh, India, South East Asia and also in western countries. Mung beans contain balanced nutrients, including dietary fiber, protein, oligosaccharides, and significant amounts of bioactive phytochemicals [3, 4]. Polyphenols in Mung bean are important sources of lipid metabolism accommodation, anti-inflammatory, antioxidant, antimicrobial, antiseptic, antihypertensive and antidiabetic effects [5].

Fig 1: Vigna radiata seeds
**Table 1**: Name of *Vigna radiata* in different languages [6, 8].

| Languages | Names |
|-----------|-------|
| Bengali   | Mug, Mung |
| Burmese   | Pe-Di-Sein, Pe-Di |
| Chinese   | Lù Dou, Luhk Dâu, Qing Xiao Dou |
| Czech     | Fazol zlatý, Mungo fazole, Vigna Zlatá |
| Danish    | Mung-Bønne |
| Dutch     | Mungboon |
| Estonian  | Munguba |
| English   | Mung bean, Green gram, Chinese Mung Bean, Golden gram, Indian Mung bean, Golden-Seeded Mung bean, Burmese Mung bean, Jerusalem Pea, Celera bean, Mung Dahl, Moong bean |
| Finnish   | Mungopapu |
| French    | Haricot mungo, Mungo, Ambérique, Haricot doré |
| German    | Mungbohne, Jerusalembohne |
| Hindi     | Maash daal |
| Ibanag    | Balataong |
| Jupagao   | Balatang Balatong |
| Indonesia | Kacang Djong, Arta Ijo |
| Italian   | Fagiolino Aureo, Fagiolino Verde |
| Japanese  | Fundou, Bundou, Ryokutou, Yaenari |
| Laotian   | Thwàx Ngo, Thwàx Khìew |
| Malay     | Cerupayar |
| Manipuri  | Kacang Hijau |
| Marati    | Mung-Hawai |
| Nepali    | Mung, Udid |
| Oriya     | Muga |
| Persian   | Maash |
| Polish    | Fasolka mung, Fasola Złota, Ola Mung |
| Portuguese| Feijão-da-china, Feijão-mungo |
| Punjabi   | Moongi |
| Russian   | Mash, Mas,’ Fasol’ Vidov, Fasol |
| Sinhalese | Bu Me, Mun |
| Spanish   | Frijol mungo, Judía mungo, Poroto chino |
| Swahili   | Mchorroko, Mchooko |
| Swedish   | Mungbōna |
| Tagalog   | Munggo, Balatong |
| Tamil     | Pasippayaru, Pasipayar |
| Telugu    | Pacha Pesalu, Pacha-Pesalu |
| Thai      | Thua Khieo, Thuaa Khiaao |
| Urdu      | Maash daal |
| Vietnamese| Dâu Xanh |

**Table 2**: Taxonomy [7, 9, 10].

| Kingdom          | Plantae |
|------------------|---------|
| Subkingdom       | Tracheobionta |
| Super Division   | Spermatophyta |
| Division         | Magnoliophyta |
| Class             | Magnoliopsida |
| Subclass          | Rosidae |
| Order             | Fabales |
| Family            | Papilionaceae |
| Subfamily         | Faboideae |
| Tribe             | Phaseolae |
| Sub tribe         | Phaseolinae |
| Genus             | Vigna |
| Species           | *radiata* |

**Synonym(s)**: *Azukia radiata* (L.) Ohwi, *Phaseolus abyssinicus* Savi, *Phaseolus aureus* Roxb., *Phaseolus radiatus* L., *Phaseolus sublobatus* Roxb., *Phaseolus trinervis* Wight & Arn.

**Plant**: Annual, erect to semi-erect, slightly pubescent herb up to 1.3 m tall.

**Stem**: Pubescent, hairs brown, stiff spreading.

**Leaves**: Leaf trifoliolate, petiole 5-21 cm long, leaflet 5-16 cm long, 3-12 cm broad, elliptic, rhomboid or ovate, the lateral somewhat oblique, entire or 2-3-lobed, acuminate, glabrous or bristly pilose on both surfaces, petiolule 3-6 mm long; stipules 1-1.8 cm long, petulate.

**Inflorescence**: Inflorescence axillary, many flowered, peduncle 2.5-9.3 cm long, bracts 4-5 mm long, pedicel 2-3 mm long, bracteoles 4-7 mm long. Calyx tube 3-4 mm long, glabrous, teeth 1.5-4 mm long, ciliate, the upper pair almost united. Corolla greenish yellow. Vexillum 1.2 cm long. Flower Bisexual, papilionaceous.

**Fruit**: Fruit 4-9 cm long, linear-cylindrical, 5-6 mm broad somewhat constricted between the seeds, pubescent, hairs spreading.
Macroscopy of seeds \[11\].

Hilum is at or almost at the level of seed coat and very short aril is present. Funicle present. Macrosclerids cylindrical with conical lumen.

Nutritional value

Mung beans is a pulse or food legume crop. It is mainly used as dried seeds and occasionally as forage or green pods or as vegetable. Dried seeds are eaten whole or split, cooked, fermented or milled and ground into flour. Confections, curries, soups, porridge and alcoholic beverages can also be made from Mung bean \[13\]. Seeds contain about 20 – 24% protein in which albumin (25%) and globulin (60%) are the main storage proteins \[13, 14\].

Mung bean protein is also rich in essential amino acids and contain aromatic amino acids, leucine, isoleucine and valine. However, it is slightly deficient in lysine, threonine, tryptophan and total sulfur amino acids \[15\]. Mung beans also contain carbohydrate content as 50 – 60%. Starch is the major carbohydrate and therefore, mung bean is typically used in making starchy noodles. Beside this, trypsin inhibitors, hemagglutinin, tannins and phytic acid are also present in Mung bean, which are essential for enhancing the strength of bones and teeth. Mung bean rich in lecithin which reduces the liver fat and promotes digestion and eliminating toxins. Minerals like calcium and potassium are also reported in Mung bean, which are essential for the growth of bones and teeth.

Table 3: Nutritional value of seeds \[8\].

| Nutrient                          | Amount (mg/100g) |
|----------------------------------|------------------|
| Energy                           | 347 kcal/100g    |
| Carbohydrates                    | 62.62g/100g      |
| Proteins                         | 23.86g/100g      |
| Ash                              | 3.32g/100g       |
| Total dietary fibers             | 16.3g/100g       |
| Total sugars                     | 6.60g/100g       |
| Fats                             | 1.15g/100g       |
| Lipids (g/100g)                  |                  |
| Total saturated fatty acids      | 0.348            |
| Total mono unsaturated fatty acids | 0.161            |
| Total poly unsaturated fatty acids | 0.384            |
| Micro-minerals (mg/100g)         |                  |
| Copper                           | 0.941            |
| Iron                             | 6.74             |
| Manganese                       | 1.035            |
| Selenium                        | 8.2              |
| Zinc                             | 2.68             |
| Macro-minerals (mg/100g)         |                  |
| Calcium                          | 132              |
| Magnesium                       | 189              |
| Phosphorus                       | 367              |
| Potassium                        | 1246             |
| Sodium                           | 15               |
| Vitamin A (Beta Carotene)        | 68               |
| Vitamin B1 (Thiamin)             | 0.621            |
| Vitamin B2 (Riboflavin)          | 0.233            |
| Vitamin B3 (Niacin)              | 2.251            |
| Vitamin B12 (Pantothenic acid)   | 1.910            |
| Vitamin B6 (Pyridoxine)          | 0.382            |
| Vitamin B9 (Folate)              | 625              |
| Vitamin C (Ascorbic acid)        | 4.8              |
| Vitamin E (alpha-tocopherol)     | 0.51             |
| Vitamin K (Phylloquinone)        | 9.0              |

Ethnomedicine

Mung bean is reported to help in preventing the loss of nails and hairs, and also reduces the risk of hypercholesterolemia, coronary heart disease, decreases the absorption of toxic substances and prevent cancer \[16\]. People in China are using Mung bean as medicine for more than 2000 years for detoxification activities, gastrointestinal problems, refresh mentality, skin moisture, decreasing the stroke of heat and other related problems with summer heat \[9\].

Table 4: Different traditional medicinal preparations of Vigna radiata \[17\].

| Medicaments     | Indication                  |
|-----------------|-----------------------------|
| Soup            | Fever, ascites, cough.      |
| Cold infusion   | Polydypsia, emesis.         |
| Decoction       | Bacterial skin infection.   |
| Ghee preparation| Diseases of teeth.          |
Conclusion
Medicinal uses, phytochemistry and pharmacology of Vigna radiata presented in this review could be helpful for future studies and research. The plant has good future prospective for the discovery of new molecules and pharmacological activities.

References
1. Degefa I. General Characteristics and Genetic Improvement Mung bean (Vigna radiata L.) in Ethiopia: Review Article International Journal of Agriculture Innovations and Research 2016;5(2):232-237.
2. Umata H. Evaluation of adaptability of mung bean varieties in moisture stress of eastern Harerghe zone. Agricultural Research and Technology 2018;3(2):001-004.
3. Tang D, et al. A review of phytochemistry, metabolite changes, and medicinal uses of the common food mung bean and its sprouts (Vigna radiata). Chemistry Central Journal 2014;8:4.
4. Min L. Research advance in chemical composition and pharmacological action of mung bean. Shanghai J Trad Chin Med 2001;5:18.

Table 5: Phytochemistry [8, 18, 22].

| Polyphenol class | Polyphenol sub-class | Compounds |
|------------------|----------------------|-----------|
| Anthocyanins     | Delphinidin ; Delphinidin 3-α-glucoside |
| Chalcones        | 2',4',4'-trihydroxychalcone |
| Dihydrochalcones | Phloretin |
| Dihydroflavonols | Dihydroquercetin |
| Flavanones       | Eriodictyol ; Hesperetin ; Neohesperidin ; Naringin ; Naringenin ; Naringenin 7-α-glucoside ; Neohesperidin ; 5,7-dihydroxyflavone ; Eriodictyol 7-α-glucoside |
| Flavones         | Apigenin ; Apigenin 7-α-glucoside ; Apigenin 6-c-glucoside ; Hypolaetin ; Luteolin ; Vitexin ; Isovitexin. |
| Isoflavonoids    | Kaempferol ; Kaempferol 3-α-rutinoside ; Kaempferitrin ; Quercetin ; Quercetin 3-α-glucoside ; Quercetin 3-α-rutinoside ; Myricetin ; Rhamnetin ; Rutin |
| Phenolic acids   | 4-Hydroxybenzoic acid ; Caffeic acid ; Ellagic acid ; Ellagic acid glucoside ; Gallic acid ; Gentisic acid ; Protocatechuic acid ; Vanillic acid |
| Hydroxycinnamic acids | 3-p-coumaric acid ; Chlorogenic acid ; Ferulic acid ; Feruloyl glucose ; Sitosterol ferulate ; Syringic acid |
| Hydroxycoumarins | Scopolin ; Scopoletin |
| Hydroxyphenylpropene | Rhododendrin |
| Coumestan        | |

Table 6: Pharmacology

| Part                        | Extract            | Pharmacological activity                          |
|-----------------------------|--------------------|---------------------------------------------------|
| Seed                        | Aqueous            | Anti-fungal [33], anti-hyperglycemic [24].         |
| Ethanol                     |                    | Anti-inflammatory [25, 26].                        |
| Methanol                    |                    | Anti-microbial [27].                               |
| Ethyl acetate               |                    | Antioxidant and anti-proliferative [28].          |
| Seed sprout and seed coat   | Ethanol            | Antidiabetic [29].                                 |
| Methanol and ethyl acetate  | Aqueous            | Antiseptic [30].                                   |
| Seed sprout                 | Aqueous            | Whitening cosmecutical ingredient [31].           |
| Methanol                    |                    | Anti-hypertensive [32].                            |
| Seed coat                   | Aqueous            | Estrogenic effect [33].                            |
| Leaf                        | Methanol           | Anti-septic [34].                                  |
| Compounds                   |                    | Anti-inflammatory [35].                            |
| Proteins, polypeptides, polysaccharides |             | Antioxidant                                       |
| Enzymes, peptides           |                    | Antimicrobial                                      |
| Phytoesterol                |                    | Lipid metabolism                                  |
| Proteins, amino acids       |                    | Antihypertensive                                  |
| Polyphenols                 |                    | Antidiabetic, antioxidant, antimicrobial, anti-inflammatory, antitumor, antiseptic |

5. Kahraman A, et al. Mung Bean [Vigna radiata (L.) Wilczek] as Human Food. International Journal of Agriculture and Economic Development 2014;2(2):9-17.
6. Heuzé V, et al. Mung bean (Vigna radiata). Feedipedia, a programme by INRA, CIRAD, AFZ and FAO. https://www.feedipedia.org/node/235 Last updated on July 3, 2015;10:04. 2015.
7. Mogotsi K. Vigna radiata (L.) R. Wilczek in PROTA 1: Cereals and pulses/Céréales et légumes secs. [CD-Rom]. M. Brink and G. Belay, Editors 2006, PROTA: Wageningen, Netherlands.
8. Ganesan K, Xu B. A critical review on phytochemical profile and health promoting effects of mung bean (Vigna radiata). Food Science and Human Wellness 2018;7(1):11-33.
9. USDA. Plant Database : Vigna radiata (L.) R. Wilczek mung bean 2018. [cited 2018 January 26, 11:40EST]; Available from: https://plants.usda.gov/core/profile?symbol=VIRA4.
10. Ali SI. Papilionaceae, in Flora of Pakistan, E. Nasir and S.I. Ali, Editors. Department of Botany, University of Karachi 1973.
11. Patel JD. Comparative seed coat anatomy of some Indian edible pulses. Phyton 1976;17:287-299.
12. Lambrides C, Godwin I. Mungbean, in Pulses, sugar and tuber crops. Springer 2007. p. 69-90.
13. Wang SY, et al. A non-specific lipid transfer protein with antifungal and antibacterial activities from the mung bean. Peptides 2004:25(8):1235-1242.
14. Kudre TG, Benjakul S, Kishimura H. Comparative study on chemical compositions and properties of protein isolates from mung bean, black bean and bambara groundnut. Journal of the Science of Food and Agriculture 2013;93(10):2429-2436.
15. Mubarak A. Nutritional composition and antinutritional factors of mung bean seeds (Phaseolus aureus) as affected by some home traditional processes. Food chemistry 2005;89(4):489-495.
16. Asfaw Z, et al. Mungbean (Vigna radiata (L.) Wilczek) (Fabaceae) Landrace Diversity in Ethiopia. Addis Ababa University 2015.
17. Kavya N, et al. Nutritional and therapeutic uses of mudga [Vigna radiata (L.) R. Wilczek]; A potential interventional dietary component. International Journal of Research in Ayurveda and Pharmacy 2014;5(2):238-241.
18. Lin X, W Li. The research of mung bean SOD oral liquid. Food Sci 1997;18:25-26.
19. Kruewan KL, Tongyonk K. Kangsadalampai, Antimutagenic and co-mutagenic activities of some legume seeds and their seed coats. Journal of Medicinal Plants Research 2012;6(22):3845-3851.
20. Prokudina E, et al. Rapid UPLC–ESI–MS/MS method for the analysis of isoflavonoids and other phenylpropanoids. Journal of Food Composition and Analysis 2012;26(1-2):36-42.
21. Wang M, et al. Flavonoid content in different legume germplasm seeds quantified by HPLC. Plant Genetic Resources 2008;6(1):62-69.
22. Li H, et al. Identification of the flavonoids in mungbean (Phaseolus radiatus L.) soup and their antioxidant activities. Food chemistry 2012;135(4):2942-2946.
23. Ye X, TB Ng. A chitinase with antifungal activity from the mung bean. Protein Expression and Purification, 2005;40(2):230-236.
24. Yeap SK, et al. Antihyperglycemic effects of fermented and nonfermented mung bean extracts on alloxan-Induced-diabetic mice. Journal of Biomedicine and Biotechnology 2012, 7.
25. Lee SJ, et al. Effect of mung bean ethanol extract on pro-inflammatory cytokines in LPS stimulated macrophages. Food Science and Biotechnology 2011;20(2):519-524.
26. Kang I, et al. Effects of mung bean (Vigna radiata L.) ethanol extracts decrease proinflammatory cytokine-induced lipogenesis in the KK-Ay diabese mouse model. Journal of Medicinal Food 2015;18(8):841-849.
27. Senthilkumar S, Sivakumar T. Studies on the greengram (Vigna radiata L.) sprout assisted synthesis of silver nanoparticles and their antimicrobial activities. International Journal of Nanomaterials and Biostructures 2014;4(3):52-57.
28. Kim DK, et al. Total polyphenols, antioxidant and antiproliferative activities of different extracts in mungbean seeds and sprouts. Plant Foods for Human Nutrition (Formerly Qualitas Plantarum) 2012;67(1):71-75.
29. Yao Y, et al. Antidiabetic activity of mung bean extracts in diabetic KK-Ay mice. Journal of Agricultural and Food Chemistry 2008;56(19):8869-8873.
30. Tang D, et al. A review of phytochemistry, metabolite changes, and medicinal uses of the common food mung bean and its sprouts (Vigna radiata). Chemistry Central Journal 2014;8(1):4.
31. Jeong YM, et al. Inhibitory effects of mung bean (Vigna radiata L.) seed and sprout extracts on melanogenesis. Food Science and Biotechnology 2016;25(2):567-573.
32. Hsu GSW, et al. Antihypertensive effect of mung bean sprout extracts in spontaneously hypertensive rats. Journal of Food Biochemistry 2011;35(1):278-288.
33. Battu G, et al. A phytopharmacological review on Vigna species. Pharanest 2011;2:62-67.
34. Zhu S, et al. It is not just folklore: The aqueous extract of mung bean coat is protective against sepsis. Evidence-based Complementary and Alternative Medicine : eCAM 2012, 498467.
35. Nishanthi M, et al. Evaluation of in-vitro anti-inflammatory activity of methanolic leaf extract of Vigna radiata (L.) Wileze. International Journal of Pharmacological Screening Methods 2012;2(2):88-91.