

A short review of health benefits and nutritional values of mung bean in sustainable agriculture

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Abstract. Mung beans, also known as Lu Dou, are one of the traditional soy foods consumed mainly in East Asia, especially by Chinese and Japanese. It has been used both as nutritional food and herbal medicine. Mung is a valuable plant for sustainable agriculture due to its ability to use atmospheric nitrogen. Because of energy crises and high mineral fertilizer prices cultivation of legumes become one of the most promising strategies for sustainable agriculture. The factors determining the efficiency of symbiotic process are the genetic constitution of the host plant and bacteria, environment, and technological inputs (inoculums, fertilizers and pesticides). Inoculation of mung bean with *Bradyrhizobium* enhanced nodulation, and results in increasing of shoot biomass and grain yield. The legume residues are also a good source of mineral nitrogen for the succeeding crops. Mungbean is rich in easily digestible protein, it also contains vitamin A, B1, B2, C, niacin, folate, iron, calcium, and zinc. Nutrition therapy on the basis of traditional Chinese medicine (TCM) is quite effective at treating common diseases. The most important health benefits of mung beans are anti-oxidant effects, antifungal and antimicrobial activity, anti-inflammatory activity, activity against diabetes, hypertension and cancer. Mung bean clears heat, detoxifies, reduces swelling, promotes urination, quenches thirst, aids edema in the lower limbs. It is recommended for conjunctivitis, diabetes, dysentery, summer heat, heatstroke, dehydration, edema and food poisoning.

Keywords: mung bean, traditional chinese medicine, biological nitrogen fixation, health benefits

INTRODUCTION

China is the native home to a greater diversity of the world's herbal plants than any other regions in the world. China is still at a critical point of agricultural transforma-

tion from traditional to modern methods. It has historical relationship with medicinal plants for more than 2000 years, and it was demonstrated by medicinal herbs. Traditional Chinese medicine (TCM) includes herbal medicine, acupuncture, moxibustion, massage, food therapy and physical exercise (Xu, Wu, 2009).

TCM is also an essential part of the health care system in most Asian countries, relies on natural products and has been playing a very important role in health protection and disease control for many years (Wang et al., 2017).

The aim of this research is to review health benefits and nutritional values of mung bean with considering sustainable agriculture.

MATERIALS AND METHODS

All relevant papers in English language of various researchers and scholars from different countries were collected. The keywords of mung bean, traditional Chinese medicine, biological nitrogen fixation, and health benefits were searched in Google Scholar, Scopus, Research Gate and PubMed.

TRADITIONAL CHINESE MEDICINE FOR ORGANIC LIFE

In the Chinese tradition, a meal is not just an accumulation of calories but an opportunity to supply our organs with a balance of yin and yang. Traditional Chinese medicine, which is an essential part of the health care system in most Asian countries, relies on natural products and has been playing a very important and significant role in health protection and disease control for thousands of years (Soleymani and Shahrajabian, 2012a; Ogbaji et al., 2013; Young and Shahrajabian, 2017; Ogbaji et al., 2017; Ogbaji et al., 2018; Shahrajabian et al., 2018; Soleymani and Shahrajabian, 2018; Young et al., 2018; Shahrajabian et al., 2019a; Shahrajabian et al., 2019b; Shahrajabian et al., 2019c; Sun et al., 2019).

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MUNG BEAN COMPOSITION, MEDICINAL USES
IN TRADITIONAL MEDICINE
AND MODERN PHARMACEUTICAL SCIENCE

Mung bean (*Vigna radiata*) is widely consumed as a nutritional food in the forms of cooked whole beans, flour, or sprouts (Adsule et al., 1986). In China, it has also been used as a medicinal herb for dissipating fever and detoxicating the body since the 1050s (Zhu et al., 2012). Interestingly, in the line with the ancient description, recent studies have manifested that mung bean extract and/or components such as vitexin and isovitexin can alleviate pathogenic heat and oxidative stresses (Cao et al., 2011; Chung et al., 2011). Drinking a bowl of cold sweet mung bean soup every day is a Chinese habit in summer, and it is a delicious dessert and a cold (yin energy) treat to cool down the body system in the heat. According to traditional Chinese medicine, the tiny green mung beans (lu dou) eaten as soup or congee can expel toxins. According to TCM, since mung beans are cold (yin), they help dispel internal heat, clear away toxins, promote urination and relieve hot weather ailments and rashes (Using the tiny ...). From an energetic perspective, mung beans are a surefire way to support your entire body while relieving itchy skin rashes, and detoxing and strengthening your Stomach and Liver. Most illnesses are related, on an energetic level, to poor Liver function, so it is especially important to give this organ a boost. And even though Spring is the season of the Liver, mung beans can be used throughout the year, with an added side-effect of beautiful, glowing skin (Mung Beans: A TCM ...).

Table 1. Species and common names of the two important species of *Vigna radiata*.

Species	Synonyms	Common Names
<i>Vigna radiata</i> var. <i>aureus</i>	<i>Vigna radiata</i> (L.) Wilczek	Mung bean, green gram, golden gram
	<i>Phaseolus radiatus</i> (L.)	Orgeon pea, Moong, Jerusalem pea
	<i>Phaseolus aureus</i> Roxb.	Newman pea
<i>Vigna radiata</i> var. <i>mungo</i>	<i>Vigna mungo</i> (L.) Hepper	Urd, urd bean, black gram
	<i>Phaseolus mungo</i> (L.)	Mash, mungo bean, woolly pyrol, black mapte

Table 2. Macronutrient composition of mung bean (Dahiya et al., 2015).

Macronutrient	Average [#]	Minimum	Maximum
Moisture (g/100 g)	9.80	4.10	15.20
Crude protein (g/100 g dm)	23.8	14.6	32.6
Crude lipid (g/100 g dm)	1.22	0.71	1.85
Crude fiber (g/100 g dm)	4.57	3.8	6.15
Ash (g/100 g dm)	3.51	0.17	5.87
Carbohydrate (g/100 g dm)	61.0	53.3	67.1
Energy (Kcal/100 g dm)	344	338	347

[#] Mean value of all collected data.

Species and common names of the two important species of *Vigna radiata* is shown in Table 1. Macronutrient composition of mung bean is presented in Table 2. The most important and modern pharmacology of mung bean is shown in Table 3. Selected mung bean recipes on herbal remedies is presented in Table 4. Biological activities and compounds of mung beans is shown in Table 5. Amino acids in mung bean protein isolates with levels comparing the ones adapted from FAO/WHO is presented in Table 6.

Greater amounts of potassium, nitrogen and phosphorus were taken up from intercropping soil than from the monoculture (Soleymani et al., 2011a; Soleymani and Shahrajabian, 2012b; Shahrajabian et al., 2017). Nitrogen is one of the primary limiting nutrients for plant growth in agriculture, and the productivity of many agricultural ecosystems is controlled by nitrogen availability (Broumand et al., 2010; Khoshkham et al., 2010; Shahrajabian et al., 2011; Soleymani and Shahrajabian, 2011; Soleymani et al., 2011d; Soleymani et al., 2012; Shahrajabian et al., 2013; Soleymani et al., 2013; Soleymani et al., 2016; Shahrajabian and Soleymani, 2017a; Shahrajabian and Soleymani, 2017b; Abdollahi et al., 2018). As a consequence of the persistent energy crises resulting in higher fertilizer costs, biological N₂-fixation (BNF) has become one of the most attractive strategies for the development of sustainable agricultural systems (Hayat et al., 2008). The factors determining the symbiotic process are the genetic constitution of the host plant and bacteria, environment, and technological inputs such as inoculums, fertilizers and pesticides. Balasubramanian and Sinha (1976) concluded that there was a considerable fall in the nitrogen fixation efficiency of mung beans under saline environment. Inoculation with *Bradyrhizobium* enhanced nodulation, shoot biomass and grain yield of mung bean. The legume residues can supply more mineral nitrogen to the succeeding crops than cereal residues due to their relatively high nitrogen contents (Hayat et al., 2008). Anwar et al. (2018) concluded that in organic sources application of poultry manure at the rate of 5 ton ha⁻¹ improved growth, yield and yield components of mung bean. They have recommended 30 kg ha⁻¹ with 5 tons ha⁻¹ poultry manure to the farmers. Htwe et al. (2019) concluded that *Bradyrhizobium japonicum* SAY3-7 plus *Bradyrhizobium elkanii* BLY3-8 and *Streptomyces griseoflavus*

Table 3. The most important and modern pharmacology of mung bean.

1	Protein and phospholipids can excite nerves and increase appetite, which is necessary to increase the nutrition of many important organs.
2	Polysaccharide can enhance the activity of the serum lipoprotein lipase (LPL) and in turn promote the triglyceride hydrolysis in lipoprotein so that it obtains the lipid-lowering effect, which thus can prevent coronary heart disease and angina pectoris.
3	Antimicrobial ingredients like tannin can accelerate local hemostasis and promote wound healing.
4	It is a good raw source for extracting SOD, which has very good anti-aging effect.
5	It has inhibition on staphylococci and certain virus. That is to say, it can clear heat and detoxify, which is really useful on treating acne caused by inflammation or endogenous heat.
6	One type of globulin and polysaccharide can promote animal's cholesterol to break down into cholic acid in the liver, accelerate the secretion of bile salt in bile, and reduce the intestinal absorption of cholesterol.
7	According to clinical trials reported, its active ingredients are with anti-allergic effects, which can treat hives and other diseases.
8	It is rich in trypsin inhibitors, which can protect the liver, reduce protein breakdown, and thereby protect the kidneys.
9	Through experiments, it was found with some certain preventive effect on morphine + nitrate induced mouse lung and liver cancer.
10	It is so rich in protein that the fresh mung bean milk can protect the gastrointestinal mucosa if taken orally. In addition, its protein, proteins, tannins and flavonoids can combine with organophosphorus pesticides, mercury, arsenic, and lead compounds to form precipitate and thus reduce or totally get rid of their toxicity since they are difficult to the gastrointestinal absorption.

source: Chinese Herbs Healing. Art of Herbal Remedies Revealed <http://www.chineseherbshealing.com/mung-beans/>

Table 4. Selected mung bean recipes on herbal remedies.

1	San Dou Yin from Shi Yi De Xiao Fang (Effective Formulas from Generations of Physicians). It joins hands with Chi Xiao Dou (Adzuki beans), Hei Dou (black soya bean), and Gan Cao (Licorice Root) to prevent smallpox and measles.
2	Lu Dou Yin from Jing Yue Quan Shu (Jingyue's Collected Writings). It is used alone to cook and make cold drink for the treatment of polydipsia, dark urine, and others due to hot summer weather.
3	Lu Dou Yin from Zheng Zhi Zhun Sheng (The Level-line of Patterns & Treatment). It matches with Huang Lian (Coptis Root), Ge Gen (Kudzu Root), and Licorice to detoxify the people suffering from food poisoning or poisoning induced by aconite, croton, arsenic and other toxics.
4	Tuo Li Tang from Sheng Ji Zong Lu (Complete Record of Holy Benevolence). It is coupled with Ru Xiang (Frankincense) to treat carbuncle on the back and vomiting and pain due to a number of pathogens attacking heart.
5	Lu Dou Yin from Huo You Xin Shu (The Heart Book of Pediatrics). It is formulated with Coptis, Kudzu, and Licorice to cure irritability, nausea, vomiting or thirst due to eating medicine of hot nature by mistake.

source: Chinese Herbs Healing. Art of Herbal Remedies Revealed <http://www.chineseherbshealing.com/mung-beans/>

Table 5. Biological activities and compounds of mung beans (Tang et al., 2014).

Biological activities	Biological compounds
Antioxidant effects	Proteins, polypeptides, polysaccharides, polyphenols
Antimicrobial activity	Enzymes, peptides, polyphenols
Anti-inflammatory activity	Polyphenols
Anti-diabetic effects	Polyphenols
Lipid metabolism accommodation	Phytosterol
Anti-hypertensive effects	Proteins, amino acids
Anti-tumor effects	Polyphenols, mung bean trypsin inhibitor fragments
Anti-sepsis effects	Polyphenols, aqueous extracts from mung bean coat

Table 6. Amino acids in mung bean protein isolates with levels comparing the ones adapted from FAO/WHO (Zhu et al., 2018).

MBPI levels	Amino acids	MBPI (mg g ⁻¹)	FAO/WHO (mg g ⁻¹)
Overview	Total amino acids	800.2	
	Total essential amino acids	348.2 (43.51%) ^a	
	Total aromatic amino acids	96.7 (12.08%) ^a	
	Total sulfur amino acids	13.0 (1.63%) ^a	
Higher levels	Phenylalanine + Tyrosine	90.3	63
	Leucine	74	66
	Lysine	62.4	58
	Valine	46.3	35
	Isoleucine	39.1	28
	Histidine	27.9	19
Lower levels	Threonine	28.4	34
	Methionine + cysteine	13	25
	Tryptophan	6.4	11
Not mentioned by the FAO/WHO	Glutamic acid/glutamine	125.4	
	Aspartic acid/asparagines	85.3	
	Arginine	64.4	
	Serine	38.5	
	Alanine	36.6	
	Glycine	32.2	
	Proline	30	

MBPI – mung bean protein isolates.

^a Percent of amino acids, relative to total amino acids in MBPI.



Figure 1. Mung bean seeds (A), sprouts (B) and plant with pods (C).

are effective bacteria that can be used together as biofertilizer for the production of economically important leguminous crops, especially mung bean and soybean. Hayat et al. (2008) showed that N₂ fixation capacity of mung and mash beans was enhanced by application of phosphorus fertilization. Legume-cereal sequence also enhanced biomass and grain yield of subsequent wheat. Benefits of legumes, especially mung beans have also been attributed to control of cereal diseases and insect pests and improvements in soil structure.

Mung bean seeds, sprouts and plant with pods has been shown in Figure 1.

SUMMARY

Mung bean, as other legumes, is able to use free nitrogen thanks to symbiosis with certain microorganisms that convert elemental nitrogen into ammonia. Biological N₂-fixation (BNF) has become one of the most attractive strategies for the development of sustainable agricultural systems (Hayat et al., 2008). The factors determining the symbiotic process are the genetic constitution of the host plant and bacteria, environment, and technological inputs such as inoculums, fertilizers and pesticides. The legume residues can supply more mineral nitrogen to the succe-

eding crops than cereal residues due to their relatively high nitrogen contents. Benefits of mung beans have also been attributed to control of cereal diseases and insect pests and improvements in soil structure (Zhu et al., 2018).

Mungbean is rich in easily digestible protein, it also contains vitamin A, vitamins B1, B2, C, niacin, folate, and iron, calcium, zinc. Anti-nutrients are phytic acid, tannins, hemagglutinins, and polyphenols (Dahiya et al., 2015).

In traditional Chinese medicine, mung beans are cool in nature and sweet in taste. They act on the heart and stomach and have many healing properties. Mung beans can clear heat, promote urination, lower blood pressure and cholesterol, treat pesticide poisoning and lead poisoning, treat burns, alcoholism and food poisoning (Chan, 2014).

In Chinese cuisine, whole mung beans are used to make a dessert, which is served either warm or chilled. Shelled mung beans and mung bean paste are made into ice cream or frozen ice pops. Mung bean paste is used as a common filling for Chinese mooncakes in China. Also in China, the boiled and shelled beans are used as filling in glutinous rice dumplings eaten during the dragon boat festival. The beans may also be cooked until soft, blended into a liquid, sweetened and served as a beverage, popular in many parts of China (Chan, 2014).

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