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A critical review on phytochemical profile and health promoting effects of mung bean (*Vigna radiata*)

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Abstract

The seeds and sprouts of mung bean are very common cruise in Asia. Evidence showed that bioactive compounds in mung bean have emerged as an increasing scientific interest due to their role in the prevention of degenerative diseases. All data of *in vitro, in vivo* and clinical studies of mung bean and its impact on human health were collected from a library database and electronic search. Botanical, phytochemical and pharmacological information was gathered and orchestrated. Remarkable studies have been demonstrated, showing the enhancement of metabolites in mung bean during the sprouting process, which possesses various health benefiting bioactive compounds. These compounds have been frequently attributed to their antioxidant, anti-diabetic, antimicrobial, anti-hyperlipidemic and antihypertensive effect, anti-inflammatory, and anticancer, anti-tumor and anti-mutagenic properties. In this critical review, we aimed to study the insight of the nutritional compositions, phytochemistry, and health-promoting effects of mung bean and its sprouts. The various curative potential of mung bean provides successive preclinical outcomes in the field of drug discovery and this review strongly recommends that mung bean is an excellent nutritive legume, which modulates or prevents chronic degenerative diseases.

Keywords: Mung bean; Nutritional composition; Phytochemistry; Health promoting effects

Abbreviations: ABTS, 2, 2′-azinobis 3-ethyl-benzothiazoline-6-sulphonic acid; ACC, acetyl-CoA carboxylase; ALP, alkaline phosphatase; ALT, alanine transaminases; AST, aspartate transaminase; BUN, blood urea nitrogen; C/EBPα, CCAAT/enhancer binding protein alpha; CAT, catalase; COX2, cyclooxygenase; CPK, creatine phosphokinase; CVD, cardiovascular diseases; DAD, diode array detector; DPPH, 2, 2-diphenyl-1-picrylhydrazyl; FFA, free fatty acids; FRAP, ferric reducing antioxidant power; FTICR-MS, Fourier transform ion cyclotron resonance mass spectrometry; GC–MS, gas chromatography/mass spectrometry; GI, glycemic index; GLC, gas liquid chromatography; GLUT4, glucose transporter 4; GPx, glutathione peroxidase; GR, glutathione reductase; GSH, glutathione; GST, : glutathione s-transferase; HbA1c, glycated hemoglobin; HDL, high-density lipoprotein; HO-1, heme oxygenase-1; HPLC, high-performance liquid chromatography; HPLC-DAD, high-performance liquid chromatography with diode-array detection; IFN, interferon; IL, interleukin; kDa, kilo daltans; LDH, lactate dehydrogenase; LDL, low density lipoprotein; LOX, lipoxygenase; LPO, lipid peroxidation; MCHC, mean corpuscular hemoglobin concentration; MCH, mean corpuscular hemoglobin; MDA, malondialdehyde; MTT, 3-(4, 5-dimethyl-thiazol-2-yl)-2, 5-diphenyl tetrazolium bromide; MUFA, monounsaturated fatty acids; NADH, nicotinamide adenine dinucleotide hydrogen; NF&HIPHEN;kB, nuclear factor-kappa B; NMR, nuclear magnetic resonance; ORACL, oxygen radical absorbance capacity-fluorescein; p-AMPK, phosphorylated 5′ adenosine monophosphate-activated protein kinase; PCV, packed cell volume; p-ERK1/2, phosphorylated extracellular signal-regulated protein kinases ½; PGC-1α, proliferator-activated receptor gamma coactivator-1 alpha; PPARγ, peroxisome proliferator-activated receptor gamma; PUFA, polyunsaturated fatty acids; RNS, reactive nitrogen species; ROS, : reactive oxygen species; RT-PCR, reverse transcriptase-polymerase chain reaction; SCFA, short chain fatty acids; SGOT, serum glutamate oxaloacetate transaminase; SGPT, serum glutamate pyruvate transaminase; SOD, superoxide dismutase; STZ, : streptozotocin; TBARS, thiobarbituric acid reactive substances; TC, total cholesterol; TEAC, trolox equivalent antioxidant capacity; TGF-B1, transforming growth factor-b1; TG, triglycerides; TNF α, tumor necrosis factor alpha; UV, ultra violet; VLDL, very low density lipoprotein; WHO, World Health Organization.

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Contents

1. Introduction

Clinical evidence reported that bioactive food compounds obtained from legumes have potential health benefits and their intakes are annually growing at a rate of 10 percent [1]. WHO has also recommended that the consumption of bioactive compounds has the potential to enhance the healthcare and overcome many chronic degenerative diseases [2]. These compounds appear to the primary function of antioxidants and have become popular nowadays which focuses on the existing nutritional and therapeutic interest [3]. Antioxidants and functional foods are more satisfying to health benefits due to their defense mechanism against various degenerative diseases caused by ROS and RNS [4]. These antioxidants are derived from food legumes and cereals, which provide a diverse multitude and magnitude of activities and they also have the broader scope in managing oxidative stress in biological systems [5]. Epidemiological studies reported that the consumption of antioxidant rich food such as legumes are positively correlated with the lower occurrence of degenerative diseases including diabetes, CVD, cancer, arthritis, and Alzheimer's diseases [6,7]. Currently, more interests have been focused on the potential consumption of food legumes not only in the development of new functional ingredients for food enrichment but also the increasing health and healing potential [8,9].

Mung bean (*Vigna radiata* L.; Family: Fabaceae) is well known as green gram or moong bean. Mung bean has been consumed as a common traditional food worldwide for more than 3500 years. *Vigna radiata* used to be known as *Phaseolus aureus* Roxb. Later, many Phaseolus species were moved to the *Vigna* genus [10]. Taxonomy, vernacular and common names of mung bean are listed in Table 1. Indian farmers are widely cultivating mung beans since 3500 years ago. As the years passed by, these cultivated mung beans spread rapidly from India to China and various regions of Southeast Asia [11]. At present in China, greater than 5000 mung bean accessions have been documented by the National Crop Gene Bank of China [12]. Mung bean is a creeping annual crop growing up to 90 cm height in a warm climate up to 35°. It is a short-duration crop (75–90 days) and has wider adaptability and it extensively grows on all types of soil. It grows greatly under most adverse arid and semi-arid conditions. The leaves are alternate and trifoliate with pale green in color. Besides that, its flowers are greenish yellow to pale yellow in color. Fruits (pods) are pendent, glabrous, linear-cylindric grow up to 12 cm containing 10–15 ellipsoidal green, yellow to brown or black mottled pods [13].

Mung bean and sprouts are widely consumed as a fresh salad, vegetable or even as a common food in India, China, Bangladesh, Philippines, Thailand, South East Asia, and western countries [14]. It is well known for its detoxification properties and is used to alleviate heat stroke and reduce swelling during the summer. In the book *Ben Cao Qiu Zhen*, the Mung bean has recorded to be beneficial in the regulation of gastrointestinal problems due to superficial infections and moisturization of the skin [15]. The paste of Mung bean has been used to treat acne, eczema, dermatitis and relieving itchiness [16]. Mung bean seeds, sprouts and plant with pods are illustared in Fig. 1.

It is also used for the treatment of alcoholism which was one of the first information recorded in the classical book of *Ben-Cao-Gang-Mu* (Compendium of Materia Medica) [17]. In the traditional Chinese medicine, sprouts are said to be a *yin* or a cooling nutritive food. On top of that, it is known to have diuretic, antiscorbutic, antipyretic, antihypertensive, antidote and anticancer properties. It is prescribed by Oriental herbalists for heat, ache, inflammation, and hypertension. In the Philippines, the seeds are used either raw or cooked in matured poultice due to its protective or curative potentials for *Polyneuritis galinarum*. Whereas, in India, the seeds are used for paralysis, fever, cough, rheumatism, and neuro-diseases. They are considered as a hot and tonic, used for piles and liver diseases. Mung beans root are known to be narcotic and are given as a healing property in bone aches [18].

Mung beans are recognized for its high nutritive value, composed of about 20%–25% protein of total dry weight. Among them, globulin (60%) and albumin (25%) are the primary storage proteins. Hence, the intake of mung beans nowadays is significantly increasing together with other cereals [14,19]. The protein in the mung beans contains a greater quantity of essential amino acids, including phenylalanine, leucine, isoleucine, valine, tryptophan, arginine, methionine, and lysine [20]. Hence, it is considered to be a substantive source of dietary proteins

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