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A COMPREHENSIVE REVIEW OF RECENT ADVANCEMENTS IN VIGNA RADIATA RESEARCH: INSIGHTS INTO PHYSIOLOGY, AGRONOMIC, NUTRITIONAL, AND HEALTH PERSPECTIVES

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ABSTRACT

Aims: The primary aim of this research is to provide a better comparative understanding of the Physiology, Agronomic, Nutritional, and Health-modulating effects observed in the reviewed studies related to Vigna radiata consumption. The review paper typically highlights the antidiabetic, anticancer, anti-inflammatory, and immunomodulatory effects of Vigna radiata (mung bean). The fact that there exist inconsistencies and gaps in evidence against certain effects of mung bean & places where further research is needed is also addressed in the review paper

Place and Duration of Study: Department of Biotechnology, Techno India University, West Bengal, India; between August 2023 and July 2024.

Methodology: The paper has been prepared by conducting a comprehensive search of various mung bean-related scientific literature databases across the internet mung beans, followed by extracting relevant data from selected studies, evaluating quality assessment factors & finally summarizing and synthesizing the extracted data, including the main findings related to Vigna radiata's beneficial effects.

Results: The review work seems to be beneficial for reaffirming the significance of Vigna radiata as a natural source of immunity support and summarizing the key takeaways from the review.

Conclusion: The mung bean (Vigna radiata) is a leguminous fodder crop which is rich in nutrients and bioactive compounds, including polyphenols, polysaccharides, and polypeptides. Studies conducted in vitro and in vivo highlight the variety of mung bean's health benefits. It portrays antidiabetic, anticancer, anti-inflammatory, and immunomodulatory effects. However, it is imperative to delve deeper into the mechanisms underlying their role in preventing diseases. There are substantial knowledge gaps regarding the bioactive compounds and biological functions of mung beans. Further investigation is crucial to pinpoint additional essential components responsible for their health advantages and underscore these various components' combined effects on biological processes.

Keywords: Vigna Radiata, Mung Bean, Nutrition, Antidiabetic, Anticancer, Anti-Inflammatory, Immunomodulatory, Pulses, Bioactive

1. INTRODUCTION

Pulses, including beans, lentils, and peas, are harvested all throughout the world Ali et al. (2015) playing a crucial role both economically and nutritionally. Having pulses in one's diet is a very healthy way of meeting the diurnal nutritional recommendations and is associated with mitigating the risk of several chronic diseases. This practice of consuming cereals, pulses, and other legumes has been integral to traditional diets in India and China Anjum et al. (2011) for centuries. The

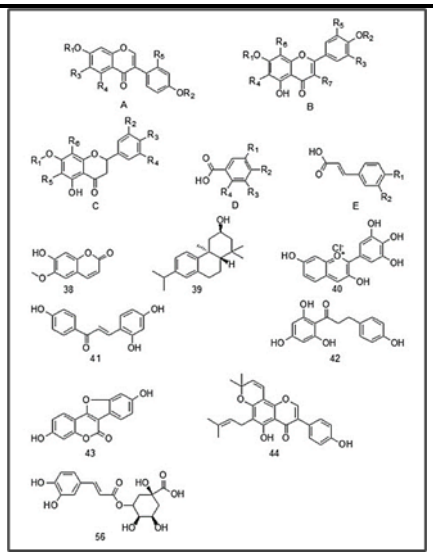
variety of pulses chosen for this particular review is the Mung bean, scientifically named Vigna radiata.

Vigna radiata (Mung bean) is a highly nutritious legume that caters to various immunological benefits Bai et al. (2016) due to its rich composition of bioactive compounds. Having such sheer beneficial importance the pulse consumed globally, especially in the Asian & South American countries, and pertains to a long history of traditional medicinal usage. It has been scientifically tested to be an extraordinary source of multi-proteins, rich dietary fiber, vitamins & minerals, etc. It also houses significant amounts of compounds quite bioactive in nature like poly-phenols, polysaccharides, and peptides. It thus transcends as a staple functional food that aids in the promotion of good health.

Upon thorough research it has been methodologically proven that mung beans (Vigna radiata) do offer a wide range of health benefits. Berihun & Molla (2017)These include improving high blood sugar conditions (hyper-glycaemia), high lipid levels Berihun & Molla (2017) in the blood (hyperlipemia), and high blood pressure (hypertension), enhanced gut health, etc. They contain vitamins (folate, vitamin B6, vitamin C) and minerals (iron, magnesium, potassium, zinc) that play key roles in immune function. Additionally, they have been found to possess the preventive potential effects against cancer Dinsa et al. (2022)and somatic melanogenesis, the process of melanin production in the skin. Furthermore, mung beans exhibit certain hepatoprotective properties. They actively support liver health and possess immune-modulatory activities, which can help regulate and strengthen the immune system.

Extensive R&D have successfully led to many Biotechnological advancements in improving various aspects of the crop Vigna radiata (Mung bean) which includes the crop yield, resistance to pests and diseases, vital stats/nutritional content, and sustained environmental adaptability. Adaptive Genetic engineering techniques have been accurately incorporated to introduce traits such as insect resistance, disease resistance, herbicide tolerance, and improved nutrient content in mung beans. Marker-assisted breeding (MAB) techniques that have well-facilitated the development of new crop varieties with desired traits allow breeders to select plants with specific genetic markers associated with desired traits such as drought tolerance, high yield, and nutrient content, thereby accelerating the breeding process. The genome sequence of Vigna radiata which has been chronologically put down furnishes us with valuable insights into its genetic makeup, gene function, and regulatory mechanisms. This information has enabled numerous fellow research workers to identify genes with desired characteristics for targeted genetic modification and breeding. Several biotechnological strategies have further been put into play in-order to enhance mung bean's tolerance to various environmental stresses. Biotechnological interventions have been applied to enhance the existing nutritional quality of mung beans. These include increasing protein content Duke (2012) El-Adawy (2003), improving amino acid profiles, and enhancing micronutrient levels (e.g., iron, zinc) through biofortification approaches.

The overall bio-technological research and advancements on Vigna radiata have evenly contributed to the creation of better crop varieties with improved agronomic traits, higher nutritional quality, and greater stress tolerance, thereby benefiting farmers and consumers Espín et al. (2007) alike. Taking into account the notable surge in enthusiasm for the complete utilization of crops about the Vigna genus, this review will offer a better framework for optimizing the utilization of mung beans in food products, thereby enhancing human nutrition and fostering continued progress in this domain.



1.1. VIGNA RADIATA CATERING TO VARIOUS HEALTH BENEFITS

Vigna radiata commonly called Mung bean, is a legume that furnishes with various immunological benefits due to its rich composition of bioactive compounds. Upon thorough research it has been methodologically proven that mung beans (Vigna radiata) do offer a wide range of health benefits. These include improving high blood sugar conditions (hyperglycemia), high lipid levels in the blood (hyperlipemia), high blood pressure (hypertension), enhanced gut health, etc. They contain vitamins (folate, vitamin B6, vitamin C) and minerals (iron, magnesium, potassium, zinc) that play key roles in immune function. Because it is rich in vital nutritional content and bioactive compounds, the mung bean (Vigna radiata) offers several immunity benefits Fuller (2007)

Mung bean is scientifically proven to have immense health benefits for gut microbiota. These, in particular, have been scientifically shown to benefit gut microbiota. Consumption benefits cardiovascular health by improving serum lipid profiles as they affect blood pressure, platelet activity, and inflammation favorably. For anyone living with diabetes, pulses are important sources of dietary fiber and are considered low glycemic index foods that can assist in keeping your blood glucose and insulin levels balanced. Ongoing research into the effects of pulse consumption on HIV and aging populations indicates that these foods might offer additional health benefits.

Mung bean (Vigna radiata) is one of the most widely grown legumes with an area of more than 6 million hectares worldwide thereby making up 8.5% of the total pulse area in the world. Most of the households in Asia consume lentil of these edible legumes. Because of its drought tolerance, it is common in the gardens of many tens of millions of households in Asia. Because of this nice feature, this low-input short-cycle-crop (notwithstanding that they have long roots) is cultivated quite extensively in many Asian countries (though mainly in China, India, a bit Bangladesh, Pakistan, and some Southeast Asian countries) as well as in the dry regions of Southern Europe and the warmer parts of Canada and the U.S.

Pulses, including beans, lentils, and peas, are grown worldwide, playing a crucial role both economically Ganesan & Xu (2017) and nutritionally. Having pulses in one's diet is a very healthy way of meeting the diurnal nutritional recommendations and is associated with mitigating the risk of several chronic

diseases. This practice of consuming cereals, pulses, and other legumes has been integral to traditional diets in India and China for centuries.

2. REVIEW OF LITERATURE

Pulses or Cereals (for example: beans, lentils, etc.) are being widely consumed for more than 1000 decades and are globally among the most extensively used food items. A wide variety of pulses can be grown throughout the world. This factor plays a pivotal role in making pulses important both economically as well as nutritionally. They are rich in macronutrients such as protein and fiber and serve as significant sources of essential vitamins and minerals like Fe, Zn, Vit. B9, and Mg. Regular consumption, such as half a cup of soaked beans daily, can greatly improve diet quality. This practice enhances gut health and supports the immune system through increased intake of these nutrients. Moreover, pulses contain phytochemicals, saponins, and tannins, which exhibit antioxidant and anti-cancer properties, suggesting that pulses may help prevent carcinogenic progression. Pulses, including beans, lentils, and peas, are harvested all throughout the world Ali et al. (2015)playing a crucial role both economically and nutritionally. Having pulses in one's diet is a very healthy way of meeting the diurnal nutritional recommendations and is associated with mitigating the risk of several chronic diseases. This practice of consuming cereals, pulses, and other legumes has been integral to traditional diets in India and China Anjum et al. (2011)for centuries. The variety of pulses chosen for this particular review is the Mung bean, scientifically named as Vigna radiata.

The mung bean (Vigna radiata) is an important food and forage legume that is grown in many countries of the world due to its relatively high nutritional value, particularly in terms of its mineral and vitamin content. The place 12 phenolic acids of mung bean seeds and sprouts Graham & Vance (2003),Hashiguchi et al. (2017) have been identified till now.The plant is very susceptible to fluctuations in climate and environmental stress factors. In our era, there is interest in harnessing this same process to introduce new genes from wild species into domesticated settings to create climate-resilient crops; this could be called hybridization. Vigna radiata is one such food with a high content of bioactive compounds with multiple health benefits that have been the target of extensive scientific research for years.

2.1. IMPORTANCE OF VIGNA RADIATA AS AN ADAPTIVE CROP

Mung bean, known scientifically as Vigna radiata, belongs to the genus Vigna, which includes over 100 wild species and 10 domesticated crop sets. Commonly referred to as green gram, this annual, fast-growing, warm-season legume has a short life cycle of 75-90 days and a genome size of 579 Mb with a diploid chromosome number of 2n=2x=22. This low-input crop serves as both livestock feed and green manure. Evidence from archaeological surveys and genetic diversity datasets indicates that mung bean was domesticated in India. Mung bean belongs to the genus Vigna. The wild species He (n.d.) within the genus Vigna possess adaptive genes for valuable traits, which can be utilized to develop stress-resistant crops suitable for agriculturally challenging lands. Leguminous crops generally exhibit a high level of adaptability to extreme and harsh environments. Their ability to fix nitrogen in the soil and promote sustainable agriculture, Ishikura et al. (1981)Kanatt et al. (2011) despite being a low-input crop itself, makes it stand out among all the other domesticated crop varieties from the same genus. This is an

annual crop. That can extensively sustain its growth on most types of soil which includes arid and semi-arid regions as well. A warmer climate, with temperatures between 28-35°C, promotes better seed germination and overall growth performance for mung beans. This self-pollinated diploid legume, known for its high nutritional value and nitrogen-fixing capability, is a short-duration fodder crop often associated with dryland agriculture. Despite its eco-friendly nature, the average yield of mung beans is limited to 600-800 kg/ha due to varying seasons and climatic conditions. In the 2017-2018 season, total mung bean production was recorded at 2.01 million tons over an area of 4.26 million hectares, with an average grain yield of 472 kg/ha. Ketha & Gudipati (2018)It has significantly increased over time.

2.2. BASIC NUTRITIONAL, AGRONOMIC AND ECONOMIC IMPORTANCE OF VIGNA RADIATA

(Vigna radiata) i.e. mung bean also significantly known as green gram or golden gram and in layman's words moong daal, is a tropical grain leguminous crop Kim et al. (2012)that has immense nutritional, agronomic, and economic importance. Kirchhoff (2002)

- **Nutritional:** Mung beans are indeed a fine source of protein, fiber, vitamins, minerals, and bioactive compounds for the consumer's health.

  Being easy-digestive this pulse is likely a true replacement of animal protein in tropical diets. The sprouts of Mung bean are also rich in protein and fiber. They contain vitamins like Vit. A, B1, B2, C, and E, as well as potassium, phosphorus, and iron. Extremely essential amino acids leucine, phenylalanine, and lysine Kudre et al. (2013)are also contained by this fodder crop. It also has methionine, arginine, valine, isoleucine, and tryptophan Lambrides & Godwin (2007), which fall under essential amino acids.
- **Agronomic:** Mung beans are comparatively a sheer cost-effective crop. It can be harvested in complete tropical and subtropical regions of the world. Though they are annual at times in certain areas they can even be grown twice a year. They are also a key component of cereal-based cropping systems because they can fix atmospheric nitrogen and improve soil health.
- **Economic:** Mung beans are extensively cultivated Lee (2011)Liu et al. (2014) for human consumption, and they can also serve as livestock feed and green manure. They indeed do contribute to poverty alleviation. They often do so by ensuring food security and enhancing ecosystem resilience.

Figure 1

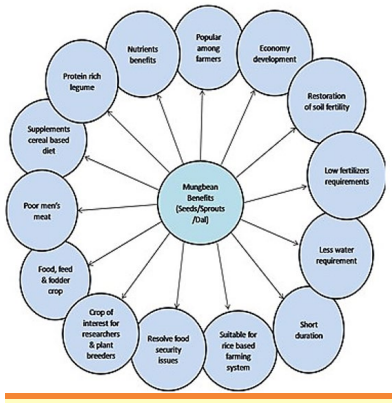


Figure 1 Characteristic Features of Mung Bean

2.3. MUNG BEANASFUNCTIONALFOOD: GENERIC HEALTHBENEFITS

The rate of mung bean consumption popularity along with certain other cereals is on the verge of a diurnal surge. It is happening because of their easy-digestible proteins, quite a bland taste, and soluble carbohydrates, offering a diet that results in low flatulence Mehta (2021)Mubarak (2004). Additionally, the seeds and sprouts of the fodder crop provides fewer calories compared to other cereals. The seed germination of Vigna radiata uplifts the nutritional value of the crop and its medicinal qualities quite significantly. This crop proved its evaluability when found to contain anti-nutrients involved in several important biological activities. These include phytic acid, tannins, hemagglutinin, trypsin inhibitors, and others. Consuming mung bean sprouts regularly supports the maintenance of beneficial gut microbiota and decreases the absorption of harmful compounds. Nakamura et al. (2015),Pal et al. (2010) It thereby prevents various metabolic disorders.

Several bioactive compounds in mung beans have been identified by recent scientific studies that have health-promoting effects. Potential of Vigna radiat (L.)Randhir (2003) The seeds, seed coats, sprouts, and leaves of mung beans contain various bioactive compounds, including organic acids, flavonoids Saini (2022b)and phenolic compounds such as vanillic acid, gallic acid, caffeic acid, cinnamic acid, protocatechuic acid, shikimic acid, and p-hydroxybenzoic acid. Detoxifying, antiscorbutic, diuretic, antihypertensive, antipyretic, antidote, and anticancer properties of these compounds have made them renowned Sawa et al. (1998) Mung beans are utilized to relieve heat stroke, address gastrointestinal issues, treat alcoholism, moisturize the skin, and reduce acne, heat, hypertension, and inflammation. Shi et al. (2016), Sosulski & Dabrowski (1984) Mung bean paste is known to treat acne, eczema, and dermatitis, and to relieve itchiness. Several studies in India have also demonstrated the use of mung bean seeds for managing piles, paralysis, fever, cough, liver diseases, rheumatism, and nervous disorders. Additionally, mung bean roots have sedative properties and are effective in treating bone aches. Nakamura et al. (2015),Tomooka et al. (2012)

Due to the innumerous health benefits that they offer Mung beans are gaining recognition as a functional food. Their popularity is increasing, particularly when consumed alongside cereals, owing to their easily digestible proteins. Mung beans as well aid in regulating gastrointestinal problems and treating alcoholism.

The diverse range of health benefits makes mung beans a valuable addition to the diet, offering both nutritional and medicinal advantages.

Figure 2

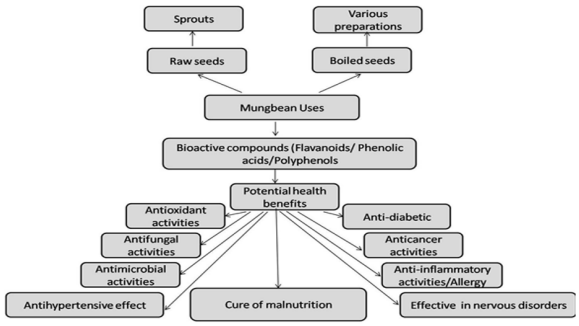


Figure 2 Health benefits of mung Bean

2.4. IMMUNOMODULATORY EFFECTS OF VIGNA RADIATA

There are millions of plant species spread across the globe. In South Asian countries, mung bean (Vigna radiata) has long been an important pulse used for therapeutic purposes to enhance health. Numerous studies have shown that mung beans can significantly combat hyperglycemia, hyperlipidemia, hypertension, tumors, cancer, heat stroke, immune suppression, inflammatory diseases, melanogenesis, and diseases triggered by ROS or RNS, as well as sepsis. These as well aid in maintaining our earth's environmental equilibrium and stability of the ecosystem. It acts an excellent source of bioactive compounds like polyphenols, polysaccharides, polypeptides, phytochemicals etc. which promote good health. Vigna radiata, is renowned for its nutritional value and potential health benefits Ullah et al. (2014)including immunomodulatory effects that are being spoken about over here:

- **Rich in Nutrients:** Mung beans are comprised of several essential nutrients. These include vitamins (like vitamins C and E), minerals (such as iron and zinc), and antioxidants. These nutrients support the generic immune functionality of the body.
- **Antioxidant Properties:** The presence of flavonoids, phenolic acids, and other antioxidant compounds helps in scavenging free radicals, thereby protecting immune cells from oxidative stress and enhancing their function.
- **Anti-inflammatory Effects:** The compounds found in mung beans, such as vitexin and isovitexin Uppalwar et al. (2020), have shown anti-inflammatory and antioxidant properties. By reducing inflammation, these compounds help modulate the immune response and prevent chronic inflammatory diseases.
- **Antimicrobial Activity:** Mung beans exhibit antimicrobial properties, which can help in defending the body against various pathogens. This antimicrobial activity supports the immune system by directly targeting harmful microorganisms.
- **Enhancement of Gut Health:** Mung beans support a healthy gut microbiome due to their rich dietary fiber content. A balanced gut is essential for optimal immune function, given that a substantial part of the immune system resides in the gut.
- **Immune Cell Activation:** Studies have shown that mung bean extracts can enhance the activity of immune cells, including macrophages and lymphocytes. This stimulation enhances the body's ability to respond to infections and other immune challenges.
- **Regulation of Immune Responses:** Mung beans have been shown to modulate immune responses Vanamala et al. (2005)by balancing pro-inflammatory and anti-inflammatory cytokines, which are signaling molecules that regulate the immune system.

  Including mung beans in one's diurnal diet can thus provide multiple benefits for the immune system, supporting both its defensive and regulatory functions. However, while the existing research is promising, further clinical studies are needed to fully understand the scope of mung beans' immunomodulatory effects and their mechanisms. Wang et al. (2004)Yaqub et al. (2010)

Specific immunomodulatory effects of Vigna radiata (mung bean), focusing on the mechanisms and the bioactive compounds involved:

1) Nutrient Composition in Relation with Immunomodulation:

- **Vitamin C:** Known for its role in enhancing the function of various immune cells and protecting against oxidative stress.
- **Vitamin E:** An antioxidant that helps in the maintenance of immune cell membranes.
- **Zinc:** Essential for the development and function of immune cells, particularly T lymphocytes and natural killer (NK) cells.
- **Iron:** Vital for immune cell proliferation and the maturation of immune cells.

2) Bioactive Compounds and Their Effects:

Phenolic Compounds such as Flavonoids (e.g., vitexin, isovitexin): These compounds display strong antioxidant properties and it helps to reduce oxidative stress and inflammation.

Phenolic Acids, good examples of which are e.g., caffeic acid, ferulic acid. These acids are known to scavenge free radicals, protecting immune cells from damage caused by oxidation. These also have anti-inflammatory effects by downregulating inflammatory pathways.

3) Antimicrobial Activity:

The extracts of mung beans have demonstrated antimicrobial properties against various bacteria. This can directly aid the immune system by reducing the load of pathogenic microbes and preventing infections.

4) Gut Health and Immune Regulation:

Dietary Fiber: The high fiber content in mung beans promotes a healthy gut microbiome, which is crucial for a balanced immune response. A healthy gut flora supports the production of short-chain fatty acids (SCFAs). These have anti-inflammatory effects on the host.

Prebiotic Effects: Mung bean fiber can act as a prebiotic, feeding beneficial gut bacteria and enhancing their growth, which in turn supports the immune system.

5) Immune Cell Activation:

Macrophages: Mung bean extracts can enhance the phagocytic activity of macrophages, improving their ability to engulf and destroy pathogens.

Lymphocytes: Extracts can also promote the proliferation and activity of lymphocytes, including T cells and B cells, which are vital for adaptive immunity.

The immunomodulatory effects Yokoyama et al. (2006) of Vigna radiata are attributed to its rich nutrient profile and the presence of bioactive compounds with antioxidant, anti-inflammatory, and antimicrobial properties. These effects collectively support and enhance various aspects of the immune system, making mung beans a valuable addition to the diet for maintaining immune health. Further research, especially clinical trials, is needed to fully understand these benefits and their implications for human health.

2.5. GUT MICROBIOTA MODULATION, ANTI-DIABETIC AND ANTI-INFLAMMATORY PROPERTIES OF VIGNA RADIATA

The high dietary fiber content of mung beans is indigestible by human enzymes, yet it is a valuable source of nutrients for the gut flora. Lactobacilli and Bifidobacteria, two types of helpful bacteria, flourish when exposed to this fiber. Mung bean fiber has a prebiotic effect that promotes the growth of good gut flora. Short-chain fatty acids (SCFAs) like butyrate, propionate, and acetate can result from this. SCFAs have several health advantages, including enhanced gut barrier integrity and anti-inflammatory properties. By consuming mung beans, the diversity of the gut microbiota can be increased. Yokoyama et al. (2006)

A more diversified microbiome results in higher levels of immunity and a decreased risk of several illnesses that they are associated with. Mung beans can lower the levels of harmful bacteria in the gut. They do so by promoting digestion, better gut health, toxin elimination, and reducing the risk of infections and inflammation. A lower glycemic index as is possessed by the mung beans, indicates that they cause a smaller hike in blood glucose levels after being consumed. This is beneficial for managing blood glucose levels, especially for people with diabetes.

Mung beans contain complex carbohydrates that are digested slowly, leading to a gradual release of glucose into the bloodstream. This gradual release helps in maintaining stable blood sugar levels.

Regular consumption of mung beans can enhance insulin sensitivity. This is vital for managing type 2 diabetes. The improved insulin sensitivity allows the body to use insulin more effectively

to lower blood glucose levels. Yokoyama et al. (2006)

Mung beans have been shown to increase levels of adiponectin, a hormone that improves insulin sensitivity and has anti-inflammatory effects.

The antioxidants present in the in-mung beans helps to reduce oxidative stress, which contributes to insulin resistance and complications related to diabetes.[50]

Mung beans can further influence the levels of cytokines, which are molecules involved in inflammation. The beans as well helps to reduce oxidative stress by scavenging free radicals, thereby preventing chronic inflammation which is a major contributor to inflammatory diseases. Liu et al. (2014).

The specimen can boost the activity of antioxidant enzymes like superoxide dismutase (SOD) and catalase, protecting cells from oxidative damage and reducing inflammation. Mung beans support the growth of beneficial gut bacteria, increase microbial diversity, and reduce harmful bacteria through their high fiber content and prebiotic effects. Mung beans assist in regulating blood glucose levels and enhancing insulin sensitivity. They lower oxidative stress, which renders them effective in managing diabetes.

2.6. ANTI-CANCER PROPERTIES OF VIGNA RADIATA

Vigna radiata (mung bean) is known for its diverse health benefits which includes significant potential anti-cancer properties that the crop displays. Mung beans are rich in antioxidants such as flavonoids and phenolic acids. These antioxidants neutralize free radicals, reducing oxidative stress, which plays a significant role in cancer development. The beans as well help in protecting cells from DNA damage caused by oxidative stress. Chronic inflammation is generally linked to various cancers that happen in a host. The mung beans can modulate body

cytokine levels, reducing pro-inflammatory cytokines (such as TNF-α, IL-1β, and IL-6) thereby mitigating inflammation-induced cancer development. They also aid in increasing anti-inflammatory cytokines (such as IL-10) in the system. The mung beans are scientifically tested to inhibit key inflammatory pathways, which plays a pivotal role in inflammation and cancer progression. Studies have been made that extracts from mung beans can cause cell cycle arrest at various stages (G1, S, and G2/M phases), inhibiting the proliferation of cancer cells.

Mung beans can inhibit the processes involved in metastasis, such as cell adhesion, migration, and invasion thereby degrading the extracellular matrix that facilitates the cancer cell movement across the host.

Research indicates that dietary choices throughout life can influence the likelihood of developing cancer at different stages of the process, often positively reducing the risk. However, cancer risk is influenced by various factors including genetic predisposition, smoking, obesity, chronic inflammation, immunosuppression, and radiation exposure. There is substantial evidence supporting the association between diets rich in beans and a decreased risk of several types of cancer. In vitro studies have suggested that peptides, proteins, and phenolic acids present in mung beans exhibit dose-dependent anti-proliferative effects against various cancer cell lines.

3. DISCUSSIONS AND CONCLUSION

The mung bean (Vigna radiata) is a leguminous fodder crop which is rich in nutrients and bioactive compounds, including polyphenols, polysaccharides, and polypeptides. Research conducted both in vitro and in vivo highlights the variety of mung bean's health benefits. It portrays antidiabetic, anticancer, anti-inflammatory, and immunomodulatory effects. Due to these health and nutritional advantages, incorporating mung bean-based functional products and nutraceuticals into one’s diurnal diet can be extremely beneficial, not only in Asian countries where it already is quite staple but globally as well.

Recent studies conducted both in laboratory settings and in living organisms have demonstrated the substantial health advantages associated with mung beans and their essential constituents. However, it is imperative to delve deeper into the mechanisms underlying their role in preventing diseases. Additionally, mounting evidence suggests reciprocal interactions between gut microbiota and components found in functional foods, which can profoundly impact overall human health. Exploring how these components interact with gut microbiota presents new avenues for potential therapeutic interventions.

Nevertheless, there are substantial knowledge gaps regarding the bioactive compounds and biological functions of mung beans. Further investigation is crucial to pinpoint additional essential components responsible for their health advantages and to underscore the combined effects of these various components on biological processes.

Additionally, mung beans are typically processed before consumption through mechanical, thermal, and biotechnological methods, which alter their functional qualities. The impact of different processing techniques on the grain's functionality is not yet fully understood. Our understanding is limited regarding how processing techniques influence the physical and chemical characteristics of mung beans and the health effects linked to different mung bean fractions. Although it's evident that mung bean constituents exhibit anti-proliferative effects on cancer cells, the precise

mechanisms through which they inhibit cancer cell growth remain incompletely understood.

CONFLICT OF INTERESTS

None.

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