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Composition of nutrients and antioxidant properties in Mung beans

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Abstract
This study comprehensively examines the composition of nutrients and antioxidant properties of mung beans (*Vigna radiata*), aiming to elucidate their potential health benefits and functional food value. Through analytical assessment, the research quantifies the macronutrients, micronutrients, and bioactive compounds present in mung beans, focusing on their role in human health. Additionally, the study investigates the impact of various cooking methods on the nutritional and antioxidant profiles of mung beans. The findings contribute to a deeper understanding of mung beans' dietary significance and promote their inclusion in health-oriented dietary practices.

Keywords: Mung beans (*Vigna radiata*), macronutrients, cooking methods

Introduction
Mung beans (*Vigna radiata*), a staple legume in many diets worldwide, have garnered attention for their health-promoting properties. Characterized by high protein content, dietary fiber, vitamins, and minerals, mung beans play a crucial role in addressing nutritional deficiencies and promoting overall health. Beyond their basic nutritional value, mung beans are rich in antioxidants, including phenolic acids and flavonoids, which are critical for combating oxidative stress and reducing the risk of chronic diseases such as cardiovascular disease, diabetes, and cancer.

Recent dietary trends emphasize the importance of whole foods with high nutritional and functional value, positioning mung beans as an essential component of such diets. However, despite their apparent health benefits, comprehensive analyses of the nutrient composition and antioxidant properties of mung beans remain sparse. Moreover, cooking methods can significantly affect the nutrient and antioxidant profiles of foods, yet the impact on mung beans is not thoroughly understood.

The global shift towards plant-based diets and the increasing demand for nutrient-dense, health-promoting foods underscore the need for detailed research on mung beans. Such research can inform dietary recommendations, food processing techniques, and consumer choices, ultimately contributing to improved public health outcomes.

Main Objective
The primary objective of this study is to provide a detailed analysis of the nutrient composition and antioxidant properties of mung beans, thereby assessing their potential as a functional food within diverse diets.

Nutritional Composition and Antioxidant Properties in Mung Bean
Mung beans are an excellent source of protein (17.36-24.89 g/100 g), with a balanced amino acid profile that is essential for human health (Shi *et al*., 2016) [1]. Fats and Fatty Acids: The fat content in mung beans ranges from 4.24–12.18 g/100 g, with palmitic acid and linoleic acid being the dominant fatty acids, contributing to their nutritional and health benefits (Wang *et al*., 2021) [2].

(Dahiya *et al*., 2015) [4], contain significant amounts of dietary fiber, promoting digestive health and aiding in cholesterol management.

Mung beans are a rich source of iron (5.9–7.6 mg/100 g), providing essential minerals for blood health and overall vitality (Dahiya *et al*., 2015) [4].

Mung beans contain a variety of phenolic compounds and flavonoids, including vitexin and isovitexin, contributing to their strong antioxidant activities. These antioxidants help in reducing oxidative stress and preventing chronic diseases (Yang *et al*., 2020) [5]. The antioxidant activities of mung beans, evaluated through various assays, have shown that these beans possess the capability to scavenge free radicals, thereby protecting the body from oxidative damage and enhancing overall health (Duh *et al*., 1997) [6].

Materials and Methods

Sample Preparation

Mung Beans Selection: Fresh, mature mung beans (*Vigna radiata*) were selected, ensuring uniform size and color to minimize variability.

Initial Processing: The beans were thoroughly washed under running tap water, soaked in distilled water for 12 hours at room temperature, and then drained to ensure uniform water content before cooking.

Cooking Treatments

Boiling: Mung beans were placed in a pot with distilled water at a ratio of 1:5 (w/v) and boiled at 100 °C for 10 minutes.

Steaming: Mung beans were placed in a steamer basket over boiling water, ensuring no direct contact with the water, and steamed for 10 minutes.

Microwaving: Mung beans were placed in a microwave-safe container with a lid, with minimal water just covering the bottom of the container, and microwaved on high power (800W) for 5 minutes.

Control Group: A batch of mung beans was left uncooked to serve as the control.

Nutrient Analysis

Protein: The Kjeldahl method was used to determine nitrogen content, which was then converted to protein content by using a conversion factor of 6.25.

Dietary Fiber: The AOAC 985.29 method was applied to quantify total dietary fiber.

Vitamins and Minerals: High-Performance Liquid Chromatography (HPLC) was employed to measure vitamin C and folate concentrations. Magnesium content was determined using Atomic Absorption Spectroscopy (AAS).

Antioxidant Property Analysis

The Folin-Ciocalteu method was used, with results expressed as grams of gallic acid equivalents (GAE) per 100 grams of dry weight. The aluminum chloride colorimetric method was utilized to quantify flavonoid content, with results expressed as grams of catechin equivalents (CE) per 100 grams of dry weight. The ability to scavenge DPPH radicals was measured using a spectrophotometric method, with results expressed as mM Trolox equivalents (TE) per 100 grams of dry weight.

Statistical Analysis: Data were analyzed using one-way ANOVA followed by Tukey's HSD test for multiple comparisons. A p-value <0.05 was considered statistically significant. All experiments were performed in triplicate, and results are presented as mean ± standard deviation.

Experimental Design

Three batches of mung beans were subjected to boiling (100 °C for 10 minutes), steaming (above boiling water for 10 minutes), and microwaving (on high power for 5 minutes). A control batch was left uncooked. Post-cooking, each batch was analyzed for nutrient composition (focusing on protein, dietary fiber, vitamin C, folate, and magnesium) and antioxidant properties (total phenolic content, flavonoids, and DPPH radical scavenging activity).

Experimental Results

Treatment	Protein (g/100 g)	Dietary Fiber (g/100 g)	Vitamin C (mg/100 g)	Folate (µg/100 g)	Magnesium (mg/100 g)	Total Phenolics (g GAE/100 g)	Flavonoids (g CE/100 g)	DPPH Scavenging Activity (mM TE/100g)
Control	23.86	16.3	4.8	625	189	0.89	0.41	5.63
Boiled	22.10	15.5	3.2	590	183	0.72	0.37	4.95
Steamed	23.00	16.1	4.0	610	185	0.85	0.39	5.40
Microwaved	22.80	16.0	4.5	600	187	0.87	0.40	5.50

Discussions

Nutrient Retention and Cooking Methods

Steaming and microwaving showed minimal reduction in protein and dietary fiber content compared to boiling. This suggests that less invasive cooking methods can better preserve the structural integrity and nutritional quality of mung beans. Significant loss of vitamin C was observed in the boiled samples, likely due to leaching into the cooking water. Steaming and microwaving, being gentler, resulted in higher retention of water-soluble vitamins like vitamin C and folate. The minimal changes in magnesium content across different cooking methods indicate its stability during cooking.

Antioxidant Properties

There was a noticeable decrease in total phenolic content and flavonoids in the boiled samples, which could be attributed to the leaching of these compounds into cooking water. Steaming and microwaving preserved more of these antioxidants, likely due to reduced water contact and shorter cooking times. The decrease in DPPH radical scavenging activity in boiled samples correlates with the reduction in phenolic content and flavonoids. Steaming and microwaving maintained higher antioxidant activity, underscoring the importance of cooking method on preserving the antioxidant capacity of foods.

Conclusion

The study demonstrates that the method of cooking significantly affects the nutrient composition and antioxidant properties of mung beans. Steaming and microwaving are preferable to boiling, as they better preserve the beans' nutritional and functional qualities. These findings are vital for dietary recommendations, emphasizing cooking methods that retain the health-promoting components of mung beans. Further research should explore the impact of cooking duration and other methods on a broader range of nutrients and bioactive compounds.

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