Utilizing the Mung Bean's Biochemical and Practical Qualities to Create A High-Fiber Diet

***Dr. Rana Taj**
****Dr. Rajni Meena**

Abstract

In our study, we conducted an analysis of Mung bean to determine its composition, fiber content, and its potential to produce a high-fiber diet that could lower plasma glucose levels in diabetic rats. We evaluated the composition of Mung bean and its byproducts through percentage analysis. The results revealed that Mung bean contained 8.85% moisture, 22.9% protein, 1.04% fat, 3.8% fiber, and 3.76% ash. The percentage contents of lignin, cellulose, and total carbohydrates in Mung bean were found to be 13.9%, 6.1%, and 60.0%, respectively. Mung bean hull, on the other hand, had 4.4% moisture, 15.2% protein, 3% ash, 0.28% fat, 28.3% fiber, 4.5% lignin, 37.2% cellulose, and 47.8% carbohydrates. Further analysis showed that bleached Mung bean hull had 2.4% moisture, 3.4% ash, 0.4% fat, 36.6% fiber, 7.6% protein, 2.3% lignin, 58.8% cellulose, and 49.5% carbohydrates. The mineral analysis of Mung bean indicated the presence of Na (1800mg/100g), K (1032mg/100g), Ca (198 mg/100g), Mg (177mg/100g), and Fe (9.82mg/100g). To investigate the effect of a high-fiber diet on plasma glucose levels in diabetic rats, the rats were induced with diabetes using alloxan. The research findings demonstrated that the high-fiber diet derived from Mung bean effectively reduced plasma glucose levels in the experimental diabetic rats when compared to the control group.

Keywords: Mung bean, fiber, nutrition, biochemical function.

Introduction

Growing scientific research suggests that foods produced from plants may have a number of potential health advantages, which is pushing up demand for these foods at a pace of 5% to 10% each year. Additionally, growing international health organisations place a strong focus on the need for dietary components with a variety of functional qualities to enhance health status and avoid chronic illnesses. In Pakistan, the mung bean (Vignaradiata), sometimes known as green gramme, is a significant pulse crop. It is a die based on grain in the majority of Asian nations. Mung beans are a significant component of Asian vegetarian diets due to their high protein content (23%) and complex carbs (dietary fibre). Numerous bioactive substances found in beans have been shown to decrease blood cholesterol significantly, as well as the risk of diabetes, obesity, and coronary heart disease.

One of the most significant early summer-growing legumes, mung beans or green beans are extensively planted across the tropics and subtropics and may be produced using a variety of cropping strategies. It is a significant component of the diets of a great deal of people in Pakistan,

India, Thailand, Indonesia, the Philippines, and China. It may be eaten in a variety of ways and forms, including as boiled, with vegetables or meat, as a dessert, or mixed into bread or cakes. It may be used to create sprouts for vegetable meals and egg rolls. Mung beans are renowned for their reduced flatulence and easy digestion. They have high levels of provitamin A and phosphorus and are mostly devoid of antinutritional elements. A meal rich in amino acids is created by combining mungbean's high protein levels and high lysine/low methionine amino acid profile with cereals' high carbohydrate and low lysine/high methionine content.

Mung bean is particularly well-known in China for its capacity for detoxifying and is said to calm mental tensions, enhance body temperature control, and aid in the summertime reduction of edoema. Numerous studies have shown that it is also required for moisturising the skin, regulating the excretion system, and enhancing digestion. Mungbean seeds and sprouts are used frequently in Pakistan, India, Bangladesh, South East Asia, and western nations in addition to traditional recipes as a fresh salad vegetable or staple meal. Mung beans have also been shown to have anticancer effects through a variety of pathways. Recombinant plant nucleases R-TBN1 and R-HBN1 were discovered to be effective against melanoma tumours and were roughly 10-times more powerful than bovine seminal ribonuclease (RNase). These nucleases are comparable to those generated from pine pollen and mung beans. These recombinant plant nucleases seem to be stable biochemical agents that may be targeted as possible anticancer cytostatics because of their high efficiency and comparatively minimal cytotoxicity.

Overall, mung bean ingestion on a regular basis may control enterobacterial flora, lessen the absorption of hazardous chemicals, lower cholesterol levels, lower the risk of coronary heart disease, and prevent cancer.

The present study's objectives were to identify the nutritional makeup of mung beans and their hypocholesterolemic impact on hypercholesterolemic rats. Mung beans are a high-fiber food item that may lower the risk of cardiovascular disease more than other soluble fibre sources. Therefore, testing this assumption on chicks is one of the study's goals.

Materials and methods

For the duration of the investigation, samples of mung bean (seed) and hull were purchased from a local market in Lahore. For cleaning, the mung bean and hull were sieved. The mungbean grains and hull were dried, and all foreign objects were taken out. Ziplock bags were used to keep the cleaned grains and hulls for further processing and analysis. For proximate analyses, mung beans and their hulls were employed.

Proximate Analysis: The weight differential between the Mung bean sample before and after 4 hours of oven drying at 120 degrees Celsius and 4 hours of ether-based fat extraction in a Soxhlet extractor served as a gauge for the sample's moisture content11. Ash contents were evaluated using the Kruawan K. et. al. technique.11 Each determination used 3-5g of dried sample. By using the Kjeldahl technique, the crude protein content of Mung bean and hull was determined. Fibre Tech System-M (Tecator) digestion with acid and alkali was used to determine the fibre content.

Calculated Lignin: The ASTM 1961 standard technique was used to calculate the lignin content. Using this approach, 1g of the defatted sample was refluxed for two hours with 70 mL of the 1.25% H2SO4. Following a hot water wash, a chloroform wash was performed on the refluxed sample. A washed sample was exposed to 72% H2SO4 for four hours while being stirred continuously. The sample was burned at 550oC for 4 hours after being filtered (with 10–12 mL of distilled water added).

Calculating Cellulose: Refluxing is a technique for estimating cellulose.1g of the defatted sample was refluxed for two hours with 15 mL of 80% acetic acid and 1.5 mL of concentrated HNO3.

The refluxed sample was then washed. Following thorough washing, the sample was exposed to 72% H2SO4 for 4 hours while being constantly stirred. The sample was then rinsed with distilled water until it became neutral, cleaned with alcohol to eliminate foreign materials, and ignited at 550oC for 6 hours. The last stage included filtering the sample (add 10-12 mL distilled water).

Calculating carbohydrates: The carbohydrate content was calculated using the subtraction technique. Bleaching for fibre extraction Mungbean hull were treated with food-grade hydrogen per oxide in an alkaline environment by using a few drops of 40% NaOH (pH 10-12) for 1-2 hours at a high temperature (50°C-100°C) after being thoroughly cleaned with distilled water to eliminate any contaminants. The sample was then extensively cleaned with distilled water, neutralised with 0.1% HCl, and then thoroughly cleaned once again with distilled water to eliminate any acid residue. The bleached sample was thoroughly pulverised before being dried with hot air.

Mineral evaluation: Nitric and perchloric acids were employed to breakdown the dried powdered samples before the aliquots were utilised to measure sodium, potassium, and other elements. Iron, magnesium, and calcium are present. The flame photometer was used to measure sodium and potassium. Atomic absorption spectrophotometer measurement of iron, calcium, and magnesium. Making an acid digest A 100ml digestion flask containing 1g of powdered material was used for the determination of minerals. Nitric acid (HNO3) in the amount of 10 ml was then added, and the flask was left in the dark for the night. The perchloric acid (HClO4) was added the next day in 5ml. The mixture was then put on a hot plate for 15 minutes at 50°C, after which the temperature was gradually increased to 200°C. The temperature was raised until there were no longer any perchloric acid vapours visible. Following digestion, the mixture was chilled and run through Wattman filter paper (#2) for filtration. It was then transferred to a 50ml volumetric flask and diluted with deionized water until the desired consistency was reached.

Composition of Diet fed: A 1 kg Mung bean fiber diet contains 18% casein, which is required to meet the animal's protein needs for growth and development. The formulation also included 7.5% maize oil to give the essential fatty acids. Corn starch was combined as a source of carbs.

Next, 1% of vitamins and 3.5% of a mineral combination were added to the diet. As a source of fiber, 45% of Mung bean bleached hull was employed. Water and food were available at all times.

Ingredients	Amount (%)
Mung bean fiber	45
Casein	18
Corn oil	7.5
Corn starch	25
Mineral mixture	3.5
Vitamins	1

Table 1: The ingredients in a high-fiber diet

Functional characteristics of high-bran Mung bean feed: The strength of the purposeful qualities of the Mung bean was next tested by evaluating the ant hyperglycemic effect of high fiber formulation on hyperglycemic rats using the prepared high bran meal.

Alloxan and enzymatic kits for biochemical analysis of blood serum for measurement of glucose and cholesterol level were used in the experimental design and induction of hyperglycemia.

Selection of Animals: Albino rats were chosen as the experimental animals in the current study for a number of reasons, including the fact that the biochemical and histopathological changes they undergo are relatively similar to those seen in humans, that the general physiology of rats is similar to that of humans, and that they are readily available, manageable, and affordable. Thirty healthy albino rats of either sex, weighing 200–300gm, were used in the investigation. Rats were raised in cages with regulated humidity (50-60%) and temperature (22–2°C). Rats were evenly split into three groups. Ten rats per group were divided into two groups, one of which served as the control group and the other of which got the medication separately and in combination over the course of 30 days.

Alloxan: Hyperglycemia that contains alloxan has been cited as a helpful experimental model for assessing the efficacy of hyperglycemic medications. Alloxan was injected intraperitoneally once at a dosage of 100 mg/kg body weight to induce diabetes.

Kits enzymatic: Using a spectrophotometer, the blood glucose and cholesterol levels of albino rats were measured using commercial kits from the firm Randox.

Experimental Design: There were five groupings of the creatures. Eight rats each made up each group. Alloxan, 100 mg/kg body weight, produced in 0.1mol/L citrate buffer, was injected intraperitoneally to cause diabetes. The rats used in the following tests were classified as diabetic when their blood glucose levels were over 150 mg/dl. After 10 days, the fasting blood glucose was measured in the Alloxan-treated rats to determine if they had diabetes.

Groups	Animal conditions	Treatment
1	Normal (Control)	Chick starter diet
2	Normal+high fiber diet	High fiber Mung bean (45% fiber)
3	Hyperglycemic+high fiber diet (diabetes)	High fiber Mung bean (45% fiber)

Table 2: Animal ailments and remedies

Blood collection and analysis: One millilitre of blood was drawn from the coccygeal vein of albino rats. Serum was separated by centrifuging blood for 10 minutes at 3000 rpm. The blood glucose levels of albino rats were measured using a spectrophotometer using commercial kits made by the firm Randox.

Principle: Serum glucose is estimated after enzymatic oxidation in the presence of glucose oxidase. Under the catalysis of peroxidase, the hydrogen peroxide generated combines with phenol and 4-aminophenazone to produce a red-violet quinoneimine dye that serves as an indicator.

Reaction

Glucose+ O2 +H2O →Gluconic acid + H2O2 2H2O2+4-aminophenazone+ phenol →peroxidase Quinoneimine +4H2O

Sample: Serum: If the serum was made within 39 minutes after serum collection, glucose is stable for 24 hours at + 2 to + 8°C.

Reagent: Enzyme reagent and standard are first.12 test tubes were collected, and two of them—two out of ten—were marked as blank and standard. The last 10 test tubes, which included discrete samples of rat serum from each diabetes group, were labelled as 1, 2, 3, etc. 1000 l of reagent were added to all the tubes using a micro pipette. 10 l of the kit's standard solution was added to the tube marked "standard," and 10 l of the serum sample was collected in the tubes marked "1, 2, and 3."10. After the whole of the tube contents was well mixed, all of the tubes were incubated at 37°C for 10 minutes. After incubation, the absorbance of the blank (AbsB) and the sample (AbsS) was compared to the standard (AbsStd) at a wavelength of 546 nm. The remaining samples were processed using this method.

Standard values: Fasting serum, plasma: 75-115 mg/dl.

Calculations: The following formula was used to determine the amount of glucose in serum: glucose concentration (mg/dl) is equal to (A test/A standard) multiplied by 10016. Analyses of variance (ANOVA) was used for all statistical analyses, and p values under (p0.05) were deemed statistically significant; p values over (p>0.05) were considered significant.

Results and discussion

Analysed roughly: A research was done to find out the biochemical makeup of the bleach hull and whole grain hull of the Mung bean. Moisture, ash, fat, fiber, protein, carbohydrate, and minerals (all determinations are in%) are the components of chemical analysis. Additionally, to learn more about the fiber profile (cellulose and lignin) of the hull and whole grain of the mung bean. For normal and diabetic rats, a high-fiber diet made of Mung bean grain and hull was created. One of five diets was administered to rats at will, and all measurements were made in triplicate (AOAC, 2012).

Mung bean samples	Moisture contents Mean ± S.D	Ash contents Mean ± S.D	Fat contents Mean ± S.D
Whole grain	8.85 ± 0.02	3.76 ± 0.05	1.04 ±0.03
Hull	4.4 ± 0.29	3.0 ± 0.1	0.28 ± 0.01
Bleached Hull	2.4 ± 0	3.4 ± 0.17	0.4 ± 0.01

Table 3: Mung bean (whole grain, hull, and bleached hull) moisture, ash, and fat contents

By using the three replications' standard deviation, the mean values were computed. The mean value of the moisture, ash, and fat contents in three trial samples of Mung bean were shown in Table 3. It was observed that the treated (2.4%) and untreated (2.4%) hulls of Mung bean had lower moisture values than the entire grain, which had the maximum value (8.85%).The ash levels followed a similar trend, with whole grain ash being greater (3.76%) than bleached hull (3.4%) and untreated hull (3.0%). Fat percentages for entire beans were 1.04%, bleached hulls were 0.4%, and the hull was 0.28%.

Mung bean samples	Fiber contents Mean ± S.D	Protein contents Mean ± S.D	Carbohydrates %
Whole grain	3,8 ± 0	22.9 ± 0.21	60.00
Hull	28.3 ± 0.5	16.2 ± 0.32	47.82
Bleached Hull	36.6 ± 0.58	7.6 ± 0.15	49.59

Table 4 lists the carbohydrate, fiber, and protein composition of Mung bean (whole grain, hull, and bleached hull)

By using the three replications' standard deviation, the mean values were computed.

The fiber, protein, and carbohydrate compositional data for whole and bleached mungbean seeds are compiled in Table 4. When compared to the bleached hull, it was found that the fibre content in whole grain Mung beans had the highest value.

Additionally, the Mung bean hull's reduced fiber value before bleaching was visible. The complete mung bean was analysed, and the results showed that the seeds had a protein level of 22.9% and the shell had 16.2%. However, compared to the entire mungbean (7.6%), the protein content of bleached hull was considerably ($p>0.05$) lower.

Mung bean whole grain was found to have the greatest amount of carbohydrates, or 60.0%.

While the Mung bean hull had a lower amount of carbohydrates (47.82%) before bleaching. Similar to the bleached hull, which had a greater content of carbs (49.59%) than the hull itself (47.82%).

Mung bean samples	Cellulose contents Mean ± S.D	Lignin contents Mean ± S.D
Whole grain	6.1 ± 0.17	13.9± 0.34
Hull	37.2 ± 0.26	4.5± 0.32
Bleached Hull	58.8 ± 0.76	2.3± 0.1

Table 5 lists the amounts of cellulose and lignin in the whole grain, hull, and bleached hull of the mung bean.

By using the three replications' standard deviation, the mean values were computed.

In three samples of Mung beans, the mean value of lignin content was shown in Table 5. It was determined that the Mung bean's whole grain had the highest value (13.9%), while the bleached hull had the lowest value (2.3%) and the lignin value in the hull was the opposite, at 4.5%. When compared to the hull and whole grain of the Mung bean, bleached hull had the greatest value of cellulose concentration.

Mineral analysis: Table 6 shows the findings from the mineral analysis of mung beans. Minerals were present in significant amounts in mungbean. The concentrations of Na (18 mg/100 g-1), K (1032 mg/100 g-1), Ca (198 mg/100 g-1), Mg (177 mg/100 g), and Fe (9.82 mg/100 g) were shown to be substantially higher in mung beans.

Sodium mg/100g	Potassium mg/100g	Calcium mg/100g	Magnesium mg/100g	Iron(Fe) mg/100g
18.00	1032.00	198.00	177.00	9.82

Table 6 shows the minerals included in Mung bean.

Groups	Glucose level at 1st day Mean ± SD (before alloxan)	Glucose level at 15th day Mean ± SD (after alloxan)	Glucose level at 30th day Mean ± SD
Control	116.20 ± 5.26	114.20 ± 1.48	114.20 ± 1.64
Normal+ High fiber diet	114.00 ± 4.00	113.20 ± 2.16	100.80 ± 1.92
Diabetic+ High fiber diet	115.60 ± 5.85	152.60 ± 12.66	117.00 ± 3.00

Table 7: Glucose descriptive statistics (mg/dl).

The standard deviation was applied to the mean values to compute them.

Table 7 provides information on the change in blood glucose levels after the consumption of a high-fiber Mung bean diet during a 30-day period. In this research, the control + chick starting group had a normal first-day glucose level of 116.20 5.26 mg/dl. According to p0.05, this difference was significant. While the glucose levels at 15 and 30 days were 114.201.48 and 114.201.64mg/dl, respectively. The glucose level in the second group (normal + high fiber diet) was 114.004.00mg/dl on the first day, but it reduced to 113.202.16 and 100.801.92mg/dl on the 15th and 30th days, respectively. A steady and statistically significant reduction in glucose was seen at 0.05. In comparison, the glucose levels in the third group of diabetics who had a high-fiber diet ranged from 152.60 to 115.60 mg/dl by the 15th day. Additionally, the third group's lowered glucose level at 30 days was 117.003.00mg/dl. The glucose level dropped steadily and statistically significantly (p 0.05).

In this research, the first day saw a substantial impact on glucose levels in all groups. Additionally, a significant difference was seen between the high fiber diet and the control group's glucose levels at the 15th and 30th days.

Discussion:

Mungbean is one of the key crops used to provide the majority of the human population's protein needs in feed and food. Mung beans have a greater fiber content and protein concentration than other beans. Therefore, the goal of the current research was to identify the biochemical components of various Mung bean samples and develop a high-fiber diet using the bleached hull. Hull that has been bleached is used as dietary fiber. Mung bean was subjected to a proximate analysis in order to determine a number of factors, including moisture, ash, fat, fiber, carbs, protein, cellulose, and lignin. Proximate analysis is crucial for assessing seed quality and often serves as the foundation for calculating nutritional value. Proximate analysis of the Mung bean sample (Mung bean whole grain, Mung bean hull, and Mung bean bleached hull) and the hypocholesterolemic impact of a high-fiber Mung bean diet are provided in Tables 3 to 6, which corroborate previous research on Mungbean variants by Phadgung P.T.

Whole grain had a higher moisture content value than the hull, which was followed by bleached hull. Shuchen and his partner observed comparable outcomes with entire Mung beans in 2009. The percentage value of the ash contents in the three samples also exhibited a little variation. However, compared to hull and Mung bean bleached hull, whole Mung beans had the greatest ash concentration. Previous researchers19 have also completed work along similar lines. In the current analysis, it was discovered that three separate Mung bean samples included the least level of crude fat. In comparison to the whole grain of Mungbean, the percentage value of fat in Mung bean hull and bleached hull is comparatively low. Mung beans are well known for being a strong source of fiber and protein20. Due to its higher fiber content, it has a lower additional glycemic index than whole Mung beans and their hull, making it potentially beneficial for persons with blood sugar issues. The bleached Mung bean hull has a noticeably higher fiber content than the other two samples, according to chemical examination of Mung bean samples (whole Mung bean, Mung bean hull, and bleached Mung bean hull). However, although the amount of fiber grew throughout the bleaching process, the amounts of moisture, fat, protein, and lignin dropped. The fiber contents of the Mung bean samples are quite close to those recommended by Adel A. et al. A useful meal for digestion is bleached mungbean hull, which has a high fiber content. Legumes have a high fiber content, are digested slowly, have a low glycemic index, and support stable blood sugar levels and a healthy glucose metabolism.

Increased bean consumption lowers the glycemic index of meals, reducing the impact of foods with a high GI on blood sugar levels. Since Mungbean is a member of the leguminoseae family, which has members with high protein content, protein is a prominent component of Mungbean. Whole grain has a greater protein level than the hull. However, compared to whole grain and hull, the bleached hull has the lowest protein content (7.6%). Both the whole grain and hull samples' protein contents differed significantly (P 0.05). Saleem B. et al. calculated protein percentage values that were similar. In our investigation, it was determined by computed carbohydrate value that whole grain Mung beans had a higher value than bleached hull, which was followed by hull24. Additionally, it was noted that the bleached hull's percentage age cellulose content was much greater than the entire Mung bean grain's percentage age cellulose content. On the other hand, bleached hull had a lower lignin level than whole grain mung bean and hull25. According to the results of the mineral analysis of mung beans, the examined types seem to be a good source of sodium, calcium, potassium, magnesium, and ferric (iron). Mung beans may successfully help all groups meet their recommended nutritional allotment for the day. Additionally, it was discovered that while mung beans are often utilised as a protein source, they may also help those who are lacking in certain micronutrients.

The third step was determining how much the prepared formulation consumption reduced the blood glucose level. According to the study's findings, prepared mung bean diet may lower the level of glucose in hyperglycemic rats. Several blood tests were conducted to measure the impact of the glucose-lowering formulation. After 30 days, a significant drop in plasma glucose levels was seen in the diabetic High Fiber Diet group compared to control groups. This research found that normal rats may benefit from consuming 14–16 grams of high-fiber Mung bean diet (normal+high fiber diet) because it lowers plasma glucose levels. Similar to how the results of the third group of diabetic rats

revealed a beneficial impact of a high-fiber diet in the response of glucose level, the findings demonstrated that dietary fiber are useful in the treatment and management of diabetes. The current study's domino effects were consistent with those noted by Phadung in 1983. To support the long-term benefits of consuming legume fiber on health in both healthy people and patients with diseases, our experiment must be conducted.

As opposed to the control group, distinct variations in plasma glucose level were seen throughout the study's 30th day.

Conclusion

According to the results of the present research, eating a lot of fibre has a long-term impact on blood glucose levels. This study's findings support the idea that a high-fiber diet supplemented with mung beans might lower the risk of developing diabetes by lowering blood sugar levels and improving insulin sensitivity in hyperglycemic situations.

***Head & Associate Professor**
Department of Zoology
Seth R.L. Saharia Government P.G. College
Kaladera, Jaipur (Raj.)
****Head & Associate Professor**
Department of Chemistry
Seth R.L. Saharia Government P.G. College
Kaladera, Jaipur (Raj.)

References

1. Espin J.C., Garcia-Conesa M.T. and Tomas-Barberan F.A. (2007)., Nutraceuticals: facts and fiction., Phytochemistry, 68, 2986-3008.
2. Hussain A., Ali A., Akhtar J. and Yasin M. (2010)., Effect of phosphorus in combination with Rhizobium on clover., Chinese Prairie, 3, 60-63.
3. Madhujith T., Naczk M. and Shahidi F. (2004)., Antioxidant activity of common beans (Phaseolus vulgaris L.)., Journal of Food Lipids, 11(3), 220-233.
4. Thomas Robertson M.J., Fukai S. and Peoples M.B. (2004)., The effect of timing and severity of water deficit on growth, development, yield accumulation and nitrogen fixation of mungbean., Field Crop Res, 86, 67-80.
5. Jansen H.G.P., Charnnarongkul S. and Kim D.H. (1996)., The economic of mungbean cultivation in Thailand. In: Asthana A.N., Kim D.H., editors. Proceedings of recent advances mungbean research., India: Ind. Soc. Pulses Res. Kanpur, 6-23.

6. Mendoza E.M.T., Adachi M., Bernardo A.E.N. and Utsumi S. (2001)., Mungbean [Vignaradiata (L.) Wilczek] globulins: purification and characterization., J Agric Food Chem., 49(3), 1552-1558.

7. Min L. (2001)., Research advance in chemical composition and pharmacological action of mung bean., Shanghai J. Trad. Chin. Med., 5, 18.

8. Fery R.L. (1990)., The cowpea: production, utilization, and research in the United States., Horticultural Reviews, 12, 197-222.

9. Matousek J., Podzimek T., Pouckova, Stehlik J., Skvor J., Soucek J. and Matousek J. (2009)., Antitumor effects and cytotoxicity of recombinant plant nucleases., Oncol Res., 18(4), 163-171.

10. Kruawan K., Tongyonk L. and Kangsadalampai K. (2012)., Antimutagenic and co-mutagenic activities of some legume seeds and their seed coats., J Med Plants Res., 6(22), 3845-3851.