

Nutritional value of mung bean (*Vigna radiata*) as effected by cooking and supplementation

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SUMMARY. The study was conducted to improve the nutritional value of Mung (*Vigna radiata*) by supplementation with different kinds of meat. Diets were prepared using raw and cooked Mung and then cooked Mung was supplemented with poultry, mutton and beef at 10, 15, and 20 percent levels. Nutritional value of Mung was determined by chemical analysis as well as by rat assay. Mung had 25 percent protein and minor losses were observed during cooking. It had 1.21 percent lysine which was reduced by 43 percent on cooking. Other amino acids also showed losses during cooking. The Protein Efficiency Ratio (PER) of diet containing Mung was significantly reduced on cooking (1.86 vs 1.40). On the contrary cooking resulted in some improvement of Net Protein utilization (NPU) and True Digestibility (TD) of the Mung based diets. Twenty percent level of different meats showed better results in terms of PER, NPU and TD.

Key words: Mung beans, Nutritional value, Supplementation, Pakistan.

RESUMEN. Valor nutricional del frijol Mungo (*Vigna radiata*) suplementado y cocido. Este trabajo se llevó a efecto para mejorar el valor nutricional del frijol Mungo por suplementación con diferentes tipos de carne. Se prepararon dietas con frijol Mungo crudo y cocido suplementado con carne de pollo, carnero y bovino, a 10%, 15% y 20%. El valor nutricional fue determinado por análisis químico y por ensayos con ratas. El frijol Mungo tiene 25% de proteínas y se observaron pérdidas menores durante la cocción así como de algunos aminoácidos. La Relación de Eficiencia Proteínica (PER) de la dieta con frijol Mungo disminuyó significativamente durante la cocción (1,86 vs 1,40). Por el contrario, la cocción provocó un ligero incremento en la Utilización Proteínica Neta (NPU) y en la Digestibilidad Verdadera (DV) de las dietas basadas en Mungo. Un nivel de 20% de las diferentes carnes provocó mejores resultados en términos de PER, NPU y DV.

Palabras clave: Frijol Mungo, valor nutricional, suplementación, Pakistán.

INTRODUCTION

The per capita food intake of local population is estimated as 2618 calories per day and protein intake as 67.62 gram, which are 2.7 and 12.7 percent above the recommended dietary allowance, respectively. However certain groups of population like children particularly below 5 years and lactating and pregnant women have high incidence of malnutrition. The nutritional status appears to have improved with the development status of a region. The improvement is higher in urban areas and lower in rural area (1). Nearly 70 percent of population of Pakistan lives in rural areas and agriculture provides most of the work and income. According to the National Nutritional Survey (2) the diet of common man is predominantly cereal based. The poor section of the population derives major part of protein from cereal grains and some proteins is added from pulses which are in common use.

In our earlier communication we have reported the supplementation effect of various kinds of meat on the nutritional value of Gram (*Cicer arietinum*) (3). Mung (*Vigna radiata*) is one another commonly consumed legume in

Pakistan. India, Central and South East Asia. The area under cultivation for this crop in Pakistan is 168 thousand hectares and the total annual production is about 63 thousand tons. The quality of protein obtained from pulses is superior to that of wheat, particularly in such amino acid as lysine, threonine and tryptophan. Since foods of animal origin are relatively rich in sulphur amino acids, inclusion of small amounts of animal protein would increase the protein quality of pulse protein (4-7). The present study deals with the effect of cooking and supplementation on the nutritional quality of Mung.

MATERIALS AND METHODS

Mung was procured from the local market and dried in hot air oven. Flour was obtained by grinding and sieved through 20-mm mesh sieve. The flour was stored in air tight glass jars at room temperature until use. Similarly flour was obtained after cooking the Mung by conventional method, using natural gas as fuel. Cooking was carried at 100 °C for 30-40 minutes and then on low flame at simmering temperature until the seed became tender. After cooking, the

samples were air-dried first and then oven dried, pulverized and stored in jars as explained above. Casein (Merck, used for the preparation of standard diet), Corn Oil and Maize starch was also purchased from the market.

Mineral and vitamin mixture

Mineral mixture was prepared according to Oser (8) by mixing salts of different minerals obtained from Merck. Vitamin mixture was prepared according to the formula of Miller and Bender (9). Vitamins used for the preparation of mixture were obtained from E. Hoffman. La Roche, Ltd (Switzerland).

Formulation of diets

The experimental diets were prepared using raw as well as cooked Mung. These diets were computed on 10 per cent crude protein basis. Diets were also prepared by blending the Mung with different kind of meats i.e. poultry, mutton and beef in such a way that 10, 15 and 20 of crude protein of cooked Mung bean diet is replaced by the crude protein derived from poultry, mutton or beef. Casein diet served as standard and nitrogen free diet was used to determine the endogenous nitrogen. The composition of diets is shown in Table 1.

TABLE 1
Percent composition of experimental diets

Diets	Maize starch	Casein	Ingredients*				
			Raw Mung	Cooked Mung	Poultry meat	Mutton meat	Beef meat
Standard	56.12	12.5	-	-	-	-	-
Nitrogen free	68.62	-	-	-	-	-	-
containing raw Mung	25.14	-	43.48	-	-	-	-
containing cooked Mung	27.80	-	-	40.82	-	-	-
Cooked Mung+10% poultry	30.10	-	-	36.74	1.78	-	-
Cooked Mung+15% poultry	31.25	-	-	34.70	2.67	-	-
Cooked Mung+20% poultry	32.40	-	-	32.66	3.56	-	-
Cooked Mung+10% mutton	29.92	-	-	36.74	-	1.96	-
Cooked Mung+15% mutton	36.86	-	-	34.70	-	2.94	-
Cooked Mung+20% mutton	32.04	-	-	32.66	-	3.92	-
Cooked Mung+10% beef	30.05	-	-	36.74	-	-	1.83
Cooked Mung+15% beef	31.18	-	-	34.70	-	-	2.74
Cooked Mung+20% beef	32.35	-	-	32.61	-	-	3.66

*In addition each diet contained glucose 15%, corn oil 5%, vitamin mixture 3.5%, mineral mixture 3.13%, choline chloride 0.15%, inositol 0.10%, calcium carbonate 2.0% and di calcium phosphate 2.5%.

Biological assay

Biological evaluation was carried out according to the method of Bhatti et al. (3,10). At the end of trial, The nitrogen content of diets, feces and carcasses of each group of rats was determined by Kjeldahl's method. Data thus obtained was used to workout Protein Efficiency Ratio (PER), True Digestibility (TD) and Net Protein Utilization (NPU).

Proximate analysis

Samples of Mung were analysed for its proximate composition (Moisture, Crude Protein, Ether extract, Crude fibre, Total ash, Nitrogen free extract (NFE), according to AOAC methods (11). Samples of different types of meat were analysed for protein contents only.

Amino acid analysis

Amino acid analysis of Mung was done by the method of

Spackman, et al (12) on Beckman - Model 120C Amino Acid Analyzer.

Statistical analysis

The experimental data regarding various parameters i.e. PER, TD, and NPU were subjected to analysis of variance using completely randomized design. The analysis was computed using Statview 512+ as software. Multiple comparison of means was made by Fisher PLSD test (13).

RESULTS AND DISCUSSION

Chemical composition

(a) Proximate composition

The proximate composition of Mung is given in Table 2. Mung had 8.25 percent moisture. It is reported in the literature that moisture content of the Mung ranged from

8.78 to 9.30 percent (6,14,15), however much higher moisture content has also been reported (16). The variations may be due to location and varietal differences.

TABLE 2
Proximate composition of Mung
g/100 g

	Raw Mung	Cooked Mung
Moisture	8.25	7.50
Crude protein	25.00	24.50
Ether extract	2.83	2.15
Crude fiber	1.68	1.25
Nitrogen free extract	65.86	68.10
Ash	4.63	4.00

The protein content of Mung was 25 percent. On the basis of data reported by different workers the protein in Mung has been observed to range between 23.0 to 29.0 percent (6,15,16). Location and variety affect protein content of Mung (17). Dehusking generally result in slight elevation of protein content of the seeds while cooking cause a decrease in it. Mung was found to contain 2.83 percent ether extract. Afzal (6), Augustin and Klein (15) and Siddique (16) reported a lower range of fat. The data from different workers showed that fat in Mung ranged from 1.0 to 1.5 percent (17). These variations could be due difference in variety. Hymowitz *et al* (18) suggested that breeding high protein cultivars of Mung would lead to reduction in total oil content of the seed. Mung was found to contain 1.68 percent fibre. Fibre content of Mung has reported to range from 1.6 to 3.3 percent (17). Augustin and Klein (15) and Siddique (16) reported higher fibre content. As low as 0.57 percent crude fibre has also been (6). Such variations were probably due to varying extent of dehulling. Nitrogen free extract content of raw Mung in this study was 65.86 percent. However, a somewhat higher content of soluble carbohydrates has been reported in the literature (6,15,16). Savage and Deo (17) reported soluble carbohydrates to range from 60.1 to 71.9 percent. Mung was found to contain 4.63 percent ash in this study. Our results do not agree with those of Afzal (6), Augustin and Klein (15), Siddique (16), and Savage and Deo (17) who reported a lower ash content.

(b) Amino acid composition

The results of amino acid analysis of Mung protein have been summarized in Table 3.

Mung contained 1.21 percent lysine. Siddique (16) reported slightly higher values for lysine, histidine, arginine, leucine, isoleucine, phenylalanine and valine. He reported slightly lower value for threonine. However, Savage and Deo

(17), reported very high values for these amino acids. Eggum (19) also reported a very high value of lysine in Mung as compared with the results of the present study. These differences may be due to varieties and method of flour preparation. Pulses are generally higher in lysine and tryptophan but lower in sulphur containing amino acids than most cereal (20). The comparison of amino acid profile of raw Mung with an ideal protein showed that sulphur containing amino acids were the limiting amino acids (21). The amino acid composition of Mung has been reported to vary considerably depending on the location and the year when the seed are grown (22). Infestation with insects during storage also results in significant reduction in some of the essential amino acids like lysine and threonine (23).

TABLE 3
Amino acid composition of Mung (%)

Amino acid	Raw Mung	Cooked Mung	% of Reference*
Lysine	1.21	0.68	76.83
Histidine	0.55	0.17	-
Arginine	0.93	0.63	-
Threonine	1.19	1.09	95.20
Leucine	1.47	0.80	16.33
Isoleucine	0.82	0.56	48.23
Phenylalanine	0.78	0.63	52.00
Valine	1.08	0.38	2.43
Alanine	0.50	0.39	-
Tyrosine	2.96	0.14	-

* Egg Albumin

(c) Effect of cooking

Minor losses of nutrients were observed during cooking (Table 2). Jood *et al* (24) reported significantly higher soluble sugar in cooked seeds and higher level of reducing sugar than non reducing sugar on cooking. Legumes must be cooked before they are consumed, to make them palatable and to destroy numerous toxins they contain like trypsin inhibitors, lectins, polyphenols, tanins, lethrogens, etc. (25). Cooking has been shown to reduce trypsin inhibitors (26). Katria *et al.* (27) observed greater loss of antinutrients on cooking.

The availability of amino acid is affected by the method of cooking. It was observed that cooking of Mung lowered the lysine and all other amino acids (Table 3). Gerevani and Theophilus (28) showed that available lysine of roasted Mung was less than in boiled. Lysine content of Mung has been shown to decrease when heated at 120°C, (17). Roasting of Mung and winnowing to remove the charred seed coat had an adverse effect on the total lysine content of the remaining seeds (29).

Biological evaluation

The results of biological evaluation of Mung without and with supplementation of different types of meats have been summarized in Table 4 and 5, respectively.

(a) Protein Efficiency Ratio (PER)

The PER of diets containing Mung flour to provide 10 percent protein was observed to be 1.86 in this study. Afzal (6) reported slightly higher PER. Data from different workers indicated that PER of raw Mung ranged from 0.59 to 1.7 (17). Cooked rice based diet showed marginally higher PER when supplemented with Mung than soybean (29). Mung protein extract addition at 10 present level to bread has shown an increase in the protein content by 41 percent and PER by 73 percent. (30). James and Hove (31) reported the PER of Mung improved significantly when it was supplemented with methionine and cystine. Cooking of Mung significantly ($P<0.05$) reduced the PER (1.40) probably due to adverse effect on certain amino acids (6). Various studies reported in literature showed that PER of cooked Mung ranged from 0.9 to 2.9. Legume protein has low biological value compared

with animal protein and the seed of Mung are no exception. The major deficiency is in the sulphur containing amino acids, particularly methionine. The PER of diets Containing Mung supplemented with different levels of poultry, mutton and beef meat showed significant variation. An increase in PER was observed with the increase in the level of supplemental meat and at 20 percent levels the PER values were the highest. However, these values were still lower than the diets containing raw Mung (1.58 to 1.65 vs 1.86).

TABLE 4
Comparison of experimental diets containing Mung only with standard casein diet

Parameters	Standard	Diets	
		Raw Mung	Cooked Mung
PER	2.08 ± 0.05a	1.86 ± 0.08b	1.40 ± 0.29c
TD	89.48 ± 0.42a	76.38 ± 0.72b	78.55 ± 0.53c
NPU	55.76 ± 0.42a	44.70 ± 0.75b	47.40 ± 0.70c

Means within a row followed by different letters are significantly different at $P<0.05$ level.

TABLE 5
Biological evaluation of experimental diets containing cooked Mung and different supplementary levels of poultry, mutton and beef

Parameters studied	Kind of meat	Level of supplementation (%)		
		10	15	20
Protein Efficiency Ratio	Poultry	1.45 ± 0.35a	1.50 ± 0.46a	1.60 ± 0.06b
	Mutton	1.47 ± 0.03a	1.58 ± 0.02b	1.65 ± 0.06b
	Beef	1.43 ± 0.03a	1.46 ± 0.29a	1.58 ± 0.05b
True Digestibility	Poultry	80.22 ± 1.16a	81.34 ± 0.40ac	82.28 ± 0.40bc
	Mutton	74.43 ± 0.06a	81.26 ± 1.00b	86.53 ± 0.45c
	Beef	79.72 ± 0.30a	81.18 ± 0.30a	85.37 ± 2.27b
Net Protein Utilization	Poultry	45.44 ± 0.23a	48.45 ± 1.99ac	50.39 ± 0.95bc
	Mutton	47.25 ± 0.52a	49.48 ± 0.42ac	51.31 ± 0.64bc
	Beef	47.25 ± 0.19a	46.98 ± 2.44ac	49.68 ± 2.76bc

Means within a row followed by different letters are significantly different at $P<0.05$ level

(b) True Digestibility (TD)

The TD of Mung diet was observed to be 76.38, which was slightly improved by cooking to 78.55. Cooking has been observed to improve *in vitro* protein digestibility due to greater loss of antinutrients (27). Afzal (6) however, showed a slight depression in TD of Mung from 86.70 percent in raw to 85.70 percent in cooked. Bunce *et al* (32) also found that cooking Mung resulted in a slightly reduced true digestibility. The data from different workers showed TD of raw Mung to range from 68.4 to 91.3 and that of cooked from 72.9 to 91.0 percent (17). Sayeed and Najaa (26) showed that TD of Mung

was considerably improved on cooking. The polyphenols in pulses have been reported to be responsible for lowering the digestibility (24). The low digestibility could be due to the presence of antinutritive factors in Mung.

The TD of diet containing Mung supplemented with different levels of poultry mutton and beef showed significant ($P<0.05$) variation. There was an increase in TD with the increase in the levels of supplemental meat. At 20 percent level of supplemental meats the TD increased from 76.36 in raw to 82.27-86.53 percent. This could be due to better balance of essential amino acids on supplementation.

(c) Net Protein Utilization (NPU)

Eggum *et al* (19) observed that NPU was very positively correlated with the content of lysine, a limiting factor in grain protein. Roxas *et al* (32) confirmed that the mixed diet prepared from rice and Mung was balanced in term of its total lysine and sulphur amino acid. It was observed in the present study that cooking improved the NPU value of diet containing Mung from 44.70 in raw to 47.40 in cooked form. Legume protein has low biological values when compared with animal protein and the major difference is the sulphur containing amino acids, particularly methionine. NPUs of raw Mung have been reported to range from 41.4 to 72.7 percent and that of cooked from 44.8 to 63.00 percent (17). Processing generally improved the protein quality and moist heat methods of processing improved the quality to a greater extent than dry heat methods (28). In the present study supplementation of diet containing Mung was done with different kinds of meats at three different levels. NPU values of diets containing Mung increased with the increase in the level of supplemental meat. Twenty percent level of different meats showed better results in terms of PER, NPU and TD.

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