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EVALUATION OF CHEMICAL AND NUTRITIONAL PROPERTIES OF TWO MUNG BEAN (*Vigna radiatus* L.) VARIETIES CULTIVATED IN EGYPT

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ABSTRACT: *The physical, chemical and nutritional characteristics of two varieties of mung bean named G1000 and G2010 were studied. A little difference in physical characteristics of the seeds were noticed between the two varieties. Both varieties have relatively high protein content as 26.18 and 26.33% in G1000 and G2010, respectively. The non protein nitrogen content of G1000 was higher (0.38%) than that of G2010 (0.27%). The major carbohydrate component in mung bean was the starch. The main free sugars were stachyose, raffinose, fructose, glucose and galactose . The results showed that mung bean is rich in both sodium and potassium. The methionine and tryptophan were found to be the limiting amino acids in both varieties. The results showed that mung bean seeds of both varieties contain the antinutritional substances at different levels.*

Keywords: *Mung bean, amino acid, nutritional value, chemical score, antinutritional factor*

INTRODUCTION

With the growth of the world population and animal protein shortage, legumes were found to be one of the most attractive plant product and practical solution to narrow the protein deficiency gap (Rangel *et al.*, 2003 and Urbano *et al.*, 2005).However soybean is the most studied among the sources of legumes as a plant protein, there are other sources are now being investigated such as mung bean (Meng and Ma, 2001).

Mung bean (*Vigna radiata* L.) are a potential novel protein source which has not been fully explored. It is commonly grown and consumed in many Asian countries and recently in warmer parts of Canada and the United States (El-Rify *et al.*, 2000). This crop is well adapted to the low , semiarid and subhumid tropics. It has a high yield with a good keeping quality seeds with fewer pests and diseases attack (El-Morsi and Gad-El-Hak, 1985 and Saad *et al.*, 1995). Nutritionally,it is considered antidiabetic and low glycaemic index food (Madar and Stark, 2002).It was used in preparing variety of food such as soup or salad after germination(Ramadan *et al.*,2001),supplement for cereal products(Tompson *et al.*, 1967) and a protein concentrate or isolate in fabricated foods(Hassaan *et al.*,2004).The functional properties of mung bean

protein were shown to be comparable with those of soy bean one(Sosulski *et al* .,1976).

In Egypt, food legumes are important component of the diet for the majority of population. Mung bean had been introduced for increasing the supply of plant proteins requirements for human consumption (El-Rify *et al.*, 2000). The objective of this study was to characterize and evaluate physical ,chemical and nutritional properties of two varieties of cultivated mung bean in Egypt.

MATERIALS AND METHODS

Materials:-

Mung bean samples:

Two varieties of mung bean (*Vigna radiata* L.) named G1000 and G2010 were obtained from the National Resherch Center, El-Dokki, Giza, Egypt,season 2005.

Methods:-

Physical methods:

Weight and volume of 500 seeds, density, hulls and cotyledons percentages were estimated as described by Zeina (1989). Hydration and Swelling coefficients were measured according to Hulse *et al.* (1977). The color of mung bean seeds was measured by Lovibond Tintometer.

Analytical methods:-

Moisture, ash, crude fat, crude fiber and total nitrogen were determined according to AOAC (1990). The crude protein was calculated by multiplying the total nitrogen by 6.25. Non protein nitrogen was determined in the supernatants of samples after precipitation of protein using 10% trichloroacetic acid (Singh and Jambunathan, 1981). Nitrogen content in the supernatant was determined as mentioned before (AOAC, 1990).

Total carbohydrates was calculated by difference as nitrogen free extract. Starch was determined after acid hydrolysis by Lane & Eynon method of AOAC (1990). The total soluble sugar was determined using the method of Dubois *et al.* (1956). Individual free sugars were extracted by 70% EtOH and separated by paper chromatography and identified by comparison with known standards as described by Lineback and Ke (1975). The separated free sugars were eluted with water and quantified as glucose using the method of Dubois *et al.* (1956).

The minerals namely, Cu, Mg, Co, Mn, Na, K and Ca were determined using a Perkin Elmer Atomic Absorption Spectrophotometer 2380 as described in AOAC (1990). The total phosphorus was determined colormetrically by phosphomolybdate reagent according to the method of AOAC (1990) using Spekol spectrcolorimeter (Carl Zeiss Jena, Germany).

Amino acids composition:-

Amino acids composition of mung bean protein, except tryptophan were determined after acid hydrolysis using HPLC, Shimadzu LC-10AD RF-10A fluorescence detector according to the method of AOAC (1990). Tryptophan was determined colormetrically according to the method of Sastry and Tummuru (1985).

Computation of chemical score: The chemical score was calculated according to Bhanu *et al.* (1991) as follows:

$$\frac{\text{mg of essential amino acids in 1 g test protein}}{\text{mg of essential amino acids in 1 g reference protein}}$$

Computation of A/E ratio:

The relationship between the content of an individual essential amino acid in the protein (A) and the total essential amino acids content (E) was calculated according to the FAO (1965).

Tannins were measured by the method of A.O.A.C. (1975) using Folin-Denis reagent after the samples being extracted by MeOH. Phytic acid was determined by the method of Thompson and Erdman (1982). Trypsin inhibitor activity was determined according to the method of Roy and Roa (1971) and expressed as Trypsin inhibited units mg^{-1} sample (TIU mg^{-1}).

RESULTS AND DISCUSSION

1-Physical characteristics and proximate composition of mung bean:

Table (1) shows some physical characteristics of mung bean seeds. The weight of 500 seeds of G1000 variety was slightly lower than that of G2010 which has a lower seeds volume. These differences in seeds weight and volume were reflected in the density of the seeds of both varieties.

The hulls and cotyledons percentage in both varieties ranged between 9.0 to 9.8, 91.0 to 90.2 in G2010 and G1000 varieties respectively. Zeina (1989), noticed that easy to cook beans had low value. Seeds colour as measured by Lovibond tintiometer as the function of matching yellow,blue and red colour fractions.Yellow is the predominant colour and blue is the complementary one.Generally,the colour of G2010 seeds was darker than G1000 one .

Table (1): Some physical characteristics of dry mung bean seeds.

Characteristics		Varity	
		G1000	G2010
Weight of 500 seeds (g)		27.66	30.07
Volume of 500 seeds (cm^3)		21.67	20.67
Density g/cm^3		1.28	1.45
Hulls %		9.80	9.00
Cotyledons%		90.20	91.00
Colour (Lovibond reading)			
	Blue	4.7	4.6
	Yellow	10.1	6.9
	Red	3.2	2.9

The results in Table (2) showed that through the first 9.0 hrs of soaking, the seeds of G1000 variety having the high hull percentage were hydrated faster than that of G2010 one. This may be due to the difference in the permeability of the seed hull in both varieties. At the end of the hydration period (~21 hrs) the hydration coefficient of both varieties was nearly the same.The results of swelling coefficient were parallel to the dehydration coefficient. Sefa-Dedah *et al.* (1978) stated that water absorption by cotyledons appears to be the key property that affects the cookability of beans. Zeina (1989) found that easy to cook faba bean had higher values of hydration coefficient and swelling coefficient compared to hard-to-cook.

Table (2): Hydration and swelling coefficients of mung bean seeds.

Soaking time hr.	Hydration coefficient		Swelling coefficient	
	G1000	G2010	G1000	G2010
0.0	1.00	1.00	1.00	1.00
1	1.045	1.007	1.031	1.048
2	1.115	1.020	1.172	1.105
3	1.280	1.051	1.313	1.167
4	1.444	1.119	1.502	1.248
5	1.558	1.224	1.601	1.375
6	1.362	1.408	2.033	1.665
7	2.040	1.578	2.266	1.934
8	2.154	1.792	2.423	2.204
9	2.237	1.988	2.507	2.445
21	2.445	2.559	3.189	3.395

The chemical composition of mung bean seeds are presented in Table (3).

Moisture:

The results in Table (3) indicated that, the moisture content of both varieties was very closed, 8.66 - 8.38% .This was agree with the results reported of other workers (Ismail, 1995 and El-Riffy *et al.*, 2000).

Protein:

As stated in Table (3), mung bean seeds contained a relatively high crude protein (26.18 - 26.33%) which was near to that in faba bean, 28.9% (Zeina, 1989). The crude protein content of both varieties was very closed comparable with that reported by other investigators.

The non protein nitrogen in G1000 variety was higher (0.38%) than that of G2010 (0.27%) and consequently the true protein in G2010 (24.65%) was higher than that of G1000 (23.81%)

Table (3): proximate chemical composition of two varieties of dry whole mung bean seeds.

Constituents [a]	Variety	
	G1000	G2010
Moisture	8.66	8.38
Crude protein [b]	26.18	26.33
Non protein nitrogen	0.38	0.27
True protein	21.30	24.65
Total carbohydrate [c]	54.97	54.87
Crude fiber	4.91	5.09
Crude fat	0.94	1.05
Starch	41.87	36.23
Total soluble sugars	4.84	4.32
Ash	4.34	4.28

a= on dry weight bases except moisture
b= total nitrogen X 6.25
c= by difference as nitrogen free extract

Carbohydrates:

As shown in Table (3) the total carbohydrates (nitrogen free extract) of both varieties were almost equal. Starch was the major carbohydrate component in mung bean seeds. It was represented 66-76.17%of the total carbohydrates .The main free sugars identified in mung bean were verbascoserose, stachyose, raffinose, fructose, glucose and galactose. In both varieties verbascose was the major free sugar represented 42.75% and

38.99% of free sugars in G1000 and G2010 respectively, followed by sucrose (27.91 and 25.24%), stachyose (12.21 and 16.33%) and raffinose (10.39 and 9.75%) glucose (2.88 and 2.89%), fructose (2.58 and 5.35%) and galactose (1.28 and 1.44%) of the total soluble sugars in G1000 and G2010 respectively.

The results obtained in Table (4) showed that dry mung bean contained high level of raffinose, verbascose and stachyose .These oligosaccharides can accumulate in the small intestines and produce flatus.Many treatments can be used to reduce their levels as soaking,germination,gamma irradiation and α-galactosidase enzyme(Ghazy *et al*,1992 , Mansour and Khalil,1998). El-Mahdy and El-Sebaiy (1983) reported that fenugreek seed contained 15.6% and 13.17% stachyose and raffinose of its water soluble sugars respectively.

Table (4): Free sugars content of two varieties of dry mung bean seeds.

Free sugar	G1000		G2010	
	g/100g	% of TS*	g/100g	% of TS*
stachyose	0.591	12.210	0.705	16.230
Verbascose	2.070	42.750	1.684	38.990
Raffinose	0.503	10.390	0.421	9.750
Galactose	0.062	1.280	0.062	1.440
Sucrose	1.351	27.910	1.090	25.240
Glucose	0.139	2.880	0.125	2.890
Fructose	0.125	2.580	0.231	5.350

* TS= total soluble sugars.

Crude fiber:

The results in Table (3) showed that crude fiber content was 4.91% and 5.09% in G1000 and G2010 varieties respectively. Such values were in the range reported by El-Morsi and Gad El-Hak (1985), Al-Gaby *et al.* (1993) , El-Rify *et al.* (2000), and relatively higher than those estimated by Ismail (1995).

Crude fat:

As in many legume seeds, lipids was found to be low in mung bean, at level of 0.94 and 1.05% in G1000 and G2010 varieties respectively. These data were in accordance with that of Sood *et al.* (1982), Ismail (1995) and El-Rify *et al.* (2000).

Ash and Minerals:

The data in Tables (3 and 5) revealed that, a little difference was found in ash content of both varieties. The seeds of mung bean were found to contain a high level of sodium (Na) and potassium (K) followed by phosphorus (P), calcium (Ca), magnesium (Mg) and iron (Fe). At the same time the sodium

content of G1000 (1397.4 mg/100g) was higher than that of G2010 (1315.2 mg/100g), while potassium was higher in G2010 (1151.2 mg/100g) than in G1000 (1125.74 mg/100g). Also, magnesium was found at higher level (72.7 mg/100g) in G1000 than in G2010 (26.7 mg/100g). The other determined elements Cu, Co and Zn were found to present at nearly the same level in the seeds of the two varieties.

Table (5): Minerals content(as mg/100g) of mung bean seeds

Minerals *	G1000	G2010
Cu	3.18	3.52
Mg	72.70	26.70
Zn	5.85	5.64
Co	0.32	0.32
Fe	23.85	16.08
Mn	2.07	1.85
K	1125.74	1151.52
Na	1397.40	1315.20
P	917.20	949.00
Ca	96.18	95.97

* on dry weight basis.

2-Amino acids composition and protein quality:

Tables (6 and 7) illustrate the amino acid content, chemical score, A/E ratio and limiting amino acid of mung bean seeds protein. The following amino acids were found to predominate other amino acids in the protein composition, glutamic acid (19.73 and 19.04), leucine (8.88 and 9.18), arginine (7.42 and 8.51) and valine (6.9 and 7.51) g/100g protein in G1000 and G2010 varieties respectively.

Generally, mung bean protein was considered a good source of the essential amino acids except for methionine and tryptophan when compared with the amino acids pattern suggested by FAO/WHO/UNU, 1985 for school children and adults amino acid requirements. These results were agree with those of Khan *et al.* (1979) and El-Rify (2000) which revealed that mung bean like other legumes was deficient in sulphur containing amino acids.

Table (6): Amino acid composition of two varieties of mung bean seeds protein(g AA/100g protein).

Amino acid	Variety		FAO Pattern
	G1000	G2010	
I. leucine	4.95	5.46	4.57
Leucine	8.95	8.51	5.23
Lysine	7.14	7.18	8.21
Methionine	0.78	1.05	1.12
Phenylalanine	7.21	6.24	3.63
Threonine	4.08	4.03	3.68
Tryptophan	0.78	0.82	0.80
Valine	6.48	6.95	6.19
Alanine	4.68	4.20	-
Arginine	6.96	7.88	6.52
Aspartic	15.09	14.47	-
Cystine	0.74	0.90	1.09
Glutamic	18.53	17.64	-
Glycine	4.96	4.31	-
Histidine	4.21	3.99	3.90
Proline	4.56	3.96	-
Serine	5.43	5.03	-
Tyrosine	3.00	2.94	2.89

Table (7): Chemical score, A/E ratio and limiting amino acid of two varieties of mung bean seeds.

Essential amino acid (EAA)	Whole egg mg EAA/g protein	Chemical score		A/E ratio		FAO (1985)	
		G1000	G2010	G1000	G2010	Adult	School child
I. Leucine	56	88.39	97.50	121.69	135.69	117.00	126.00
Leucine	83	107.23	102.53	221.70	211.48	171.00	198.00
Lysine	63	113.33	113.97	176.86	178.43	144.00	198.00
Methionine	32	24.38	32.81	19.32	26.09	153.00	99.00
Phenyalanine	51	141.37	122.35	178.59	155.07	171.00	99.00
Threonine	51	80.00	79.02	99.28	100.15	81.00	126.00
tryptophan	18	43.33	45.56	19.32	20.33	45.00	40.00
Valine	76	85.26	91.45	160.51	172.71	117.00	112.00
First limiting AA		Met.	Met.				
Second limiting AA.		Trp.	Trp.				

Antinutritional factors:

The results in Table (8) indicated that whole dry mung bean seeds of both varieties contained tannins (16.4 mg/100g) in both varieties ,phytic acid (674 and 518 mg/100g), trypsin inhibitor activity (16.43 and 12.55 TIU/mg sample in G1000 and G2010 respectively. These values were 1580,384-403 mg/100g and 38.3-45.2 TIU/g in faba bean(Zeina,1989).It obvious that the antinutritionalfactors in mung bean is quite low compared to the other legumes and could be reduced, or eliminated by many technological treatments.

Table (8): Antinutritional factors of mung bean seeds (on dry weight basis).

Antinutritional factor	G1000	G2010
Tannins (mg tannic acid/100g)	16.40	16.40
Phytic acid (mg/100g)	674.00	518.00
Trypsin inhibitor (TIU/mg)	16.43	12.55

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تقييم الخصائص الكيميائية والتغذوية لصنفين من بذور المانج المنزرعة فى مصر

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الملخص العربي

تمت دراسة الخصائص الطبيغية والكيميائية والتغذوية لصنفين من بذور المانج المصرية وهما G2010, G1000. اوضحت الدراسة ان هناك اختلافات بسيطة فى الصفات الطبيعية بين الصنفين, كما احتوى الصنفان على نسب متقاربة من البروتين (٢٦,١٨ ,٢٦,٣٣ %) فى كلا الصنفين على الترتيب وان احتوى الصنف G1000 على نسبة اعلى من النيتروجين غير البروتينى.

أظهرت النتائج أن النشا هو الكربوهيدرات الرئيسية (٤١,٨٧ , ٣٦,٢٣ %) فى الصنف G1000 , G2010 على الترتيب.

تبين من النتائج أن السكريات الحرة السائدة هى ستاكيوز, رافينوز , فركتوز , جلوكوز , جالاكتوز ، كما تبين من النتائج أن الميثيونين والتربتوفان هما الاحماض الامينية الحدية بالاضافة الى احتواء الصنفين على مستويات مختلفة من العوامل المضادة للتغذية.