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MUNGBEAN SEED (VIGNA RADIATA) EVALUATION AS AN ALTERNATIVE PROTEIN SOURCE IN POULTRY DIETS

Hemid, A.A. [1]; A.H. Abd El-Gawad[2] and M.M. EL- Moniary [2]

[1] Poultry Production Dept., Fac. Agric., Ain-Shams Univ., Cairo, Egypt.

[2] Animal Production Dept., National Research Centre (NRC), Dokki,Cairo, Egypt.

ABSTRACT

Chemical analysis and biological test had been done to evaluate new variety (Kawmi-1) of mungbean seeds (Vigna radiata) as an alternative protein source in poultry diets. The chemical analysis included nutrients composition and essential amino acids content. Chemical score (CS) and essential amino acids index (EAAI) values were calculated from the amino acids pattern. Total protein efficiency (TPE) determination was carried out as a biological method to evaluate protein quality.

The results of proximate analysis recorded values of: 9.53 % Moisture, 25% CP, 1.53% EE, 3.01 % CF, 3.06% Ash, 0.14% Ca, 0.59% P and 57.87% NFE. Mungbean seeds (MBS) protein appeared to have balanced essential amino acids pattern.

The chemical score values indicated that the first limiting amino acid was methionine+cystine. EAAI for MBS protein recorded 64.3 calculated based on whole egg protein. TPE value for MBS was improved significantly ($p<0.05$) by adding complementary level of methionine to achieve SBM with no significant difference (2.28 vs. 2.29 for "MBS+methionine" and SBM treatments, respectively). It could be concluded that MBS is a promising poultry feedstuff as alternative source of protein.

Keywords: *broilers, mungbean, soybean meal, protein evaluation, TPE*

INTRODUCTION

Feeding cost for poultry is considered to be the most expensive items since it represents about 60-65 % of the total costs (Scott *et al.*, 1976). Many attempts have been made to decrease the cost of feeding to the minimum levels. These attempts include replacing the expensive feedstuffs by local ingredients. The high prices and limited quantities of protein sources available for using in poultry feeds have resulted in attempts to replace soybean protein in diets by some untraditional plant protein sources.

Mungbean (Vigna radiata) is a short summer crop cultivated in many parts of the world. It is the most important grain legume in some Asian countries (Khalaf Allah, 1995) where it is very popular human foodstuff because of its high digestibility and relative freedom from the flatulence effect commonly associated with many grain legumes.

Kowmi -1 variety of mungbean (Vigna radiata) was introduced to Egypt in last few years by National Research Centre (NRC) and is cultivating now in some reclaimed areas.

Chemical composition of mungbean seeds (MBS) for major components and amino acids were carried out by some workers (Hussein, 1989, Mehta *et al.*, 1993 and Rosalah *et al.*, 1993). Mungbean contains favourable amount of protein, essential amino acids, minerals, vitamins, and energy (Khalaf Allah, 1995; Iqtidar and Saleem, 1995; El- Damhougy *et al.*, 1996, Khalil, 1996 and El- Alfy, 1998) beside its lower content of antinutritional factors (Creswell, 1981 and Chitra *et al.* ,1995). For this reason, several workers have used MBS as a feed ingredient for poultry (Creswell, 1981; Yamazaki *et al.*, 1988, El-Alfy, 1998 and El-Moniary *et al.*, 2001). However, there is little scientific literature on evaluating the biological value of MBS as a source of protein in poultry diets.

The main objective of this study was to evaluate new variety (Kowmi-1) of MBS as an alternative source of protein in poultry diets. The total protein efficiency (TPE) method was used as criterion for evaluating the protein quality of this seeds.

MATERIALS AND METHODS

The chemical composition of MBS and that of soybean meal (SBM) was determined according to A.O.A.C (1990). Amino acids in MBS and SBM were determined according to the method described by Duranti and Cerilett (1979) using the Spackman amino acid analyzer model 118/119 CL (Spackman, 1958). Methionine and cystine were detected by the procedure described by Moore (1961). The chemical score values (CS) were calculated according to the modified method of Mitchell and Block (1946) using amino acids requirement for growing chicks (0-3 weeks) according to NRC (1994).

The essential amino acids index (EAAI) was calculated according to Oser (1951). The modified method of Woodham *et al.* (1972) was employed to determine the total protein efficiency (TPE).

Ninety, one-day-old commercial broiler chicks were used in this experiment. Birds were housed in wire battery brooders provided with a thermostatically controlled heating unit. A commercial starter diet was fed during two weeks. At 14 days of age the birds were individually weighed to the nearest gram. The birds were randomly divided into three equal groups of approximately similar average initial body weight. Birds of each group were subdivided into three replicates of ten birds each. The experimental diets contain 18.4% crude protein, which was consisted of 12% crude protein provided from SBM or MBS. The composition of the basal (SBM) and tested diets (MBS or MBS + methionine) is shown in Table (1).

The experimental diets were given *ad-labium* to the experimental groups from 14 to 28 days of age. The birds in each group were individually weighed and total feed consumption were recorded at the 28^{th} day. The values of body weight gain, feed conversion ratio and total protein consumed were calculated. Then the total protein efficiency was calculated as follows:

$$TPE = \frac{\text{Weight gain of all birds in each group}}{\text{Protein consumed by each group}}$$

Data were statistically analyzed using the general linear model (SX, 1992). A simple one way classification analysis of variance was used followed by LSD test for testing the significance between means.

Table 1:The composition of the basal and tested diets used for the determination of total protein efficiency (TPE).

Ingredients %	Diets		
	SBM	MBS	MBS +Methionine
Yellow corn	41.00	41.00	41.00
Soybean meal (44%)	27.27	-	-
Mungbean (25%)	-	48.00	48.00
Corn gluten meal (62%)	4.41	4.41	4.36
Di-calcium phosphate	1.32	1.20	1.20
Lime stone	1.38	1.50	1.50
DL- methionine	-	-	0.05
Starch	19.77	1.38	1.38
Corn oil	-	1.81	1.81
Cellulose	4.15	-	-
Salt	0.40	0.40	0.40
Vit. Min. mixture	0.30	0.30	0.30
Total	100	100	100
Calculated analysis:			
Crud protein %	18.38	18.38	18.38
ME (Kcal/ Kg)	2935	2938	2938
Calcium %	0.92	0.92	0.92
Av.Phosphorus%	0.36	0.36	0.36
Methionine %	0.30	0.25	0.30
Methionine +Cystine %	0.60	0.42	0.46

RESULTS AND DISCUSSION

The chemical composition of MBS (Kawmy-1) and SBM are presented in Table (2). The results of proximate analysis, for MBS, recorded values of 9.53% moisture, 25% crude protein (CP), 1.53% ether extract (EE), 3.01 % crude fibers (CF), 3.06% ash, 0.14% calcium (Ca), 0.59% phosphorus (P) and 57.87% nitrogen free extract (NFE). It is clear that its moisture content was less than 10%, indicating the possibility of storing MBS for a long time without deleterious effect. This value of moisture content was coincided with this (9%) reported by Khalil (1996) while it was slightly lower than that (10.94%) obtained by El-Alfy (1998).

Table 2:The chemical composition of Mungbean seeds (MBS) as compared with Soybean meal 44% (SBM).

Nutrients	MBS %(1)	SBM 44% %(2)
Moisture %	9.53	11
Crude protein %	25.00	44
Ether extract %	1.53	0.8
Crude fibers %	3.01	7
Ash %	3.06	6.5
Nitrogen free extract (NFE) %	57.87	30.7
ME (K.cal. /Kg)	2500(3)	2230
Calcium %	0.14	0.29
Phosphorus (Total) %	0.59	0.65

(1) Determined. (2) According to NRC (1994). (3) According to Titus and Fritz (1971).

Crude protein value of MBS was approximately equal to those recorded by El- Khimsawy *et al.* (1998) and Abou-Zeid *et al.* (2001). They found that CP content in MBS ranged from 24 to 26%. Although MBS does not contain a high level of CP to be considered as a rich protein source as SBM, the MBS contain a reasonable value of CP, which is comparable to some legume seeds that are used in poultry diets such as Faba bean (23.3%), Pinto bean (16.4%)and Black bean (17.98%) as reported by Iqtidar and Saleem (1995). However, Annem and Rolland (1975) claimed that some legume seeds such as alfalfa seeds (35.1%) and soybean seeds (38.2%) contain higher CP values compared to that of MBS.

Ether extract (EE) value of MBS obtained in this study (1.53%) was similar to those reported by Annem and Rolland (1975) "1.4" %, Noor *et al.* (1980) "0.89-1.65" %, Khalaf - Allah (1995) "1.24" % and El-Alfy (1998) "1.32" %. This value of EE content (1.53%) was higher than the value of 0.8% reported by NRC (1994) for SBM. This could be mainly due to the extraction of a great portion of oil from soybean seeds.

Crude fibers (CF) content in MBS (3.01%) is in agreement with the results of Noor *et al.* (1980) "3.19 -3.89" %. The current results indicated that CF in MBS was lower than those obtained by Hussein (1989) "7.62" %, Khalaf-Allah (1995) "8.52"% and Abou-Zeid *et al.* (2001) "5.24"% and higher than those reported by El-Damhougy *et al.* (1996) "1.75"%.

The results in Table (2) revealed, also, that NFE content in MBS was 57.87%. It is, in general, in agreement with the published data reported by Abou-Zeid *et al.* (2001) "56.65%". Due to the high NFE content (57.87%) of MBS and also the energy value (2500 and 2230 K.cal. ME/Kg diet, for MBS and SBM, respectively) shown in Table (2), MBS can be considered a convenient source of energy in poultry diets.

The obtained results (Table 2) clearly showed that ash content in MBS (3.06%) gave nearly similar results to the values reported by Annem and Rolland (1975) "3.4%", EL-Damhoughy *et al.* (1996) "3.65%" and El-Alfy (1998) "3.32%". It can be observed that calcium content (0.14%) was lower than the range (0.27-0.65%) reported by Iqtidar and Saleem (1995) and El-Damhougy *et al.* (1996). On the other hand, phosphorus content (0.59%) was higher than those mentioned by El- Damhougy *et al.* (1996) "0.29-0.53%". When comparing MBS with SBM, it can noticed that EE and NFE values were higher in MBS than those of SBM, while CP, CF, ash, calcium and phosphorus values were lower in MBS than those reported for SBM.

Generally, the proximate analysis of MBS indicated its good nutritional value in formulating broiler rations due to its CP and NFE or ME content. The results of the chemical analysis also showed its low content of CF, which is considered to be a limiting factor in formulating poultry rations.

The essential amino acids (EAAs) content, the calculated values for chemical score (CS) and essential amino acid index (EAAI), as well as, the limiting amino acids in each tested material (MBS and SBM) are shown in Table (3). The data showed that MBS contained reasonable amount of EAAs that compared favourably with SBM. Mungbean seeds, also, had contained higher level of lysine (7.88 gm/16gm N) than SBM (6.11gm/16gm N). The EAAs content in MBS are, in general, in agreement with those obtained by El- Alfy

(1998) and Abou-Zeid *et al.* (2001). These results indicated that MBS protein appeared to have balanced EAAs pattern. It can be observed also from Table (3) that total EAAs were 55.64% and 58.35% in MBS and SBM proteins, respectively. These results revealed that MBS protein is superior to most legumes seeds such as peas (44.46%) beans (44.97%) and soybean seeds (42.89%) as mentioned by Schaible (1970).

It can be observed also from Table (3) that essential amino acid index (EAAI) of MBS were 64.29, while that of SBM was 72.07 as calculated on whole egg protein base. These results indicated that MBS protein is considered a good protein quality. Comparing amino acids content of MBS with that required for chicks growth, based on NRC (1994) values during the first three weeks of age, indicated that arginine, phenylalanine, threonine and sulfur containing amino acids are lower than that required for optimum growth, while the other amino acids being higher than that recommended for chicks growth. However, the calculated chemical score (SC) values indicated that methionine+cystine and methionine were the first limiting amino acids (FLAA) in MBS and SBM, respectively, while methionine and methionine+cystine were the second limiting amino acids (SLAA) in MBS and SBM, respectively.

Table 3:The essential amino acids (gm / 16 gm nitrogen), Chemical Score (CS), First Limiting Amino Acid (FLAA), Second Limiting Amino Acid (SLAA) and Essential Amino Acids Index (EAAI) of Mungbean seeds (MBS) as compared with Soybean meal (SBM) 44%.

ITEM	MBS [1]	SBM [2]	Whole egg [3]	Chick requirements (0-3
Arginine	4.92	7.14	6.40	5.43
Histidine	3.04	2.66	2.10	1.52
Lysine	7.88	6.11	7.20	4.78
Phenylalanine	1.43	4.91	-	3.13
Phenylalanine+ Tyrosine	8.16	9.25	10.80	5.83
Methionine	0.96	1.41	4.10	2.17
Methionine + Cystine	1.36	2.91	6.50	3.91
Threonine	3.00	3.91	4.90	3.48
Isoleucine	4.92	4.45	8.00	3.48
Leucine	8.84	7.70	9.20	5.22
Valine	5.40	4.70	7.30	3.91
Glycine + Serine	8.12	9.52	-	5.43
Total EAAs	55.64	58.35	62.40	45.99
EAAI	64.29	72.07	100	-
CS	34.78	64.98	-	100
FLAA	Methionine + Cystine	Methionine	-	-
SLAA	Methionine	Methionine + Cystine	-	-

(1) Determined.
(2) According to NRC (1994).
(3) According to Mitchell and Block (1946).

These results are in agreement with the finding of Hang *et al.* (1980), El – Khimsawy *et al.* (1998) and Abou- Zeid *et al.* (2001) who showed that the sulfur containing amino acids are the first limiting amino acid in MBS protein. Also, Hang *et al.* (1980) reported that methionine + cystine was the first limiting amino acids in pea bean and red Kidney bean.

Data of the TPE values are shown in Tale (4). There were significant differences between the two tested protein sources (MBS and SBM) in feed conversion ratio and TPE values, as SBM being superior. However TPE value for MBS was improved significantly ($P<0.05$)by adding complementary level of methionine to achieve SBM with no significant difference (2.28 *vs.* 2.29 for MBS+ methionine and SBM treatments, respectively). These results revealed that TPE were significantly reduced while feed conversion ratio was increased when birds fed MBS without any supplementation indicating that MBS protein could not completely replace SBM protein unless the limiting amino acids are covered and on the other hand, supplementation of MBS with methionine significantly improve TPE value. EL-Khimsawy *et al.* (1998) reported that supplementation of mungbean by methionine significantly ($P<0.05$) improved its biological value.

Generally, it can be concluded, from the current study, that MBS is excellent poultry feedstuff as alternative source of protein, but it is not be used as a main source of protein in poultry rations because of its low content of sulfur amino acids. Therefore, in order to improve the amino acids pattern of MBS, it can be used either in combination with other protein sources or after dietary supplementation with methionine.

Table 4:The Total Protein Efficiency (TPE) of Mungbean seeds (MBS) as compared with Soybean meal (SBM).

ITEM	Treatments		
	SBM	MBS	MBS + Methionine
Initial weight (gm/bird)	185.4 ^{a}	184.7 ^{a}	182.06 ^{a}
Final weight (gm/bird)	470.13 ^{a}	452.96 ^{a}	465.16 ^{a}
Weight gain (gm/bird)	284.73 ^{a}	268.26 ^{a}	283.10 ^{a}
Feed consumption (gm/bird)	691.13 ^{a}	712.43 ^{a}	690.63 ^{a}
Feed conversion ratio	2.43 ^{b}	2.66 ^{a}	2.44 ^{b}
Protein consumption (gm/bird)	124.40 ^{a}	128.23 ^{a}	124.31 ^{a}
TPE	2.29 ^{a}	2.09 ^{b}	2.28 ^{a}

a, b, c... means with different superscript(s)in the same row are significantly different ($P < 0.05$).

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تقييم بذور فول المانج كمصدر بروتين بديل فى علائق الدواجن

علاء عبد السلام حميد[1] ، عمرو حسين عبد الجواد[2] ، مسعد محمد على المنيرى[2] .

[1] قسم إنتاج الدواجن – كلية الزراعة – جامعة عين شمس – القاهرة .

[2] قسم الإنتاج الحيوانى – المركز القومى للبحوث – الدقى – القاهرة .

تم إجراء التحليل الكيميائى ، وإختبار بيولوجى لتقييم صنف جديد (قومى-١) من بذور فول المانج كمصدر بروتين بديل فى علائق الدواجن. شمل التحليل الكيميائى تقدير المكونات الكيميائية الأساسية وكذلك تقدير المحتوى من الأحماض الأمينية الأساسية الذى تم منه حساب قيم الدليل الكيميائى(CS) ودليل الأحماض الأمينية الأساسية (EAAI). تم أيضا إجراء تجربة بيولوجية لدراسة كفاءة البروتين الكلية (TPE) لبذور فول المانج .

أوضحت النتائج أن متوسط نسب المركبات الغذائية فى بذور فول المانج هى: ٩,٥٣ % رطوبة، ٢٥% بروتين خام، ١,٥٣% دهن خام، ٣,٠١% ألياف خام، ٣,٠٦% رماد خام، ٥٧,٨٧% كربوهيدرات ذائبة. كذلك وجد أن بروتين فول المانج متوازن فى محتواه من الأحماض الأمينية ويحتوى على نسبة عالية من الحمض الأمينى ليسين مقارنة بكسب فول الصويا. كما وجد أن الأحماض الأمينية الكبريتية هى الأحماض الأمينية المحددة فى كل من بذور فول المانج ، كسب فول الصويا .

أوضحت نتائج التجربة البولوجية أن معامل التحويل الغذائى وكفاءة البروتين الكلية (TPE) لمجموعة الطيور المغذاة على بذور فول المانج كانت أقل (معنويا) من تلك المغذاة على كسب فول الصويا ، بينما لم تظهر أية فروق معنوية فى هذه القياسات عند إضافة الحمض الأمينى ميثيونين إلى العلائق المحتوية على بذور فول المانج .

يمكن استنتاج أن بذور فول المانج تعتبر مصدرا جيدا للبروتين يمكن استخدامه فى علائق الدواجن خاصة بعد إضافة الحمض الأمينى ميثيونين للعليقة .