

Physical, Nutritional and Cooking Properties of Mungbeans Grown in Sri Lanka

I.R. Liyanage¹, G.T.N. Gunasekara¹, M.V.P. Jayasundara¹, D.R.S. Niroshani²,
E.K.E.C. Nayana¹ and H.N.K. Gunathilake¹

¹Grain Legumes and Oil Crops Research and Development Centre,
Angunakolapelessa.

² Sri Lanka Institute of Advanced Technological Education (SLIATE), Galle.

INTRODUCTION

Pulses are edible dry seeds of plants in the family Leguminosae. It provides a cheap and rich source of protein and carbohydrates. Mungbean is the most popular pulse consumed and grown in Sri Lanka. The total land extent of 11,346 ha is under mungbean (*Vigna radiata* L.) cultivation and produce $15,058 \times 10^3$ Kg with the average yield of 1.33×10^3 Kg/ha in Sri Lanka (AgStat, 2016). One of the major problems encountered in mungbean cultivation in Sri Lanka is the high demand for labor basically for the harvesting and processing. Therefore, mechanization is very much essential for the mungbean cultivation in Sri Lanka. Information on the physical properties like size, shape, density, porosity of pulse seeds is very important when designing the machines for harvesting, processing, sorting and separating seeds. Also its is important to determine nutritional composition of mungbean as it varies among the varieties. The objectives of this present study were to determine the physical, nutritional and cooking properties of two varieties, two promising lines and one farmer selection (*Pinnamun*) of mungbean grown in Sri Lanka.

MATERIALS AND METHODS

Materials

Breeder seeds of mungbean varieties (MI5 and MI6), farmer selection (*Pinnamun*) and two promising lines (MB 48 and MIMB 128) were obtained from mungbean breeder from Grain Legume and Oil Crops Research & Development Centre, Angunakolepelessa.

Physical properties

Randomly selected seeds were used to measure length (L), width (W) and thickness (T) of seeds. These three perpendicular dimensions were measured using

**** Short Communication**

a vernier caliper. The geometric mean diameter /equivalent diameter (D_m), sphericity (Φ), aspect ratio (R_a), seed volume (V) and surface area of seeds (A) were calculated using equations shown below (Mohsenin, 1970) and presented as an average of ten determinations.

$$D_m = (LWT)^{1/3}$$

$$\Phi = [(LWT)^{1/3} / L] * 100$$

$$R_a = W/L$$

$$V = \pi B^2 L^2 / 6(2L-3)$$

$$A = \pi B L^2 / 2L - B$$

$$\text{where } B = WT^{1/2}$$

The bulk density, true density and porosity were determined using methods described by Rizvi and Mittal (1997).

Nutritional composition analysis

The moisture and ash contents were determined according to published AOAC methods (AOAC, 2012). Crude protein and fat content were also determined according to the AOAC methods (AOAC, 2000).

Cooking properties

Swelling capacity, swelling index, hydration capacity and hydration index were determined according to the methods described in Adebawale *et al.*, (2005).

Statistical analysis

The data were analyzed using ANOVA (SAS) and Duncan's test and were subjected to the mean separation. The data were reported at least in triplicate.

RESULTS AND DISCUSSION

Physical properties of mungbean seeds

Size is an important physical attribute of seeds which used in screening solids to separate foreign materials and heat and mass transfer calculations. Length, width, thickness and geometric diameter are commonly used as measures of size. Length, width, thickness of mungbean varied significantly ($p \leq 0.05$) in the range of 3.59-5.23

mm, 2.65-3.99 mm and 2.62-3.89 mm, respectively (Table 1). Equivalent diameter of mungbean seeds was in the range of 2.91-4.39 mm. MI6 reported the highest and *Pinnamun* had the lowest geometric diameter. Length to breadth ratio was observed within 1.29 mm to 1.43 mm and was not significantly different among the varieties and lines of mungbean. Shape is also important in heat and mass transfer calculations and screening solids to separate foreign materials. The shape of a food material is usually expressed in terms of its sphericity and aspect ratio. Sphericity is an expression of a shape of a solid relative to that of a sphere of the same volume. Sphericity of tested types varied significantly from 78.88% to 84.23% (Table 1). Sphericity % of mungbean line MIMB128 showed significantly higher value compared to MB48. Aspect ratio of mungbean was in the range of 0.72-0.78 and was not significantly different among the varieties and lines of mungbeans tested.

Seed volume and surface area were varied significantly and were observed in the range of 11.30-30.72mm³ and 23.89-54.20mm², respectively (Table1). *Pinnamun* had the lowest seed volume and the highest was found in MI6. The 100 seed volume was in the range of 2.80-9.07ml and it differed among the cultivars. MI5 and MB48 showed significantly higher values compared to that of MI6 and *Pinnamun*.

Bulk density and true density of tested samples did not show significant differences and were in the range of 0.80-0.85 kg/l and 1.23-1.33 kg/l, respectively (Table1). Porosity of the mungben was in the range of 33.8-36.9% and significantly differed among varieties and lines (Table1).

Table 1. Physical properties of mungbean

Property	MI5	MI 6	MB48	MIMB128	Pinnamun
Length (mm)	5.23±0.47 ^{ab}	5.49±0.41 ^a	5.02±0.36 ^b	5.01±0.51 ^b	3.59±0.37 ^c
Breadth (mm)	3.79±0.24 ^a	3.99±0.33 ^a	3.53±0.33 ^b	3.87±0.19 ^a	2.65±0.24 ^c
Thickness (mm)	3.69±0.19 ^a	3.89±0.30 ^a	3.47±0.24 ^b	3.82±0.15 ^a	2.62±0.23 ^c
Length breadth ratio	1.39±0.19 ^a	1.38±0.13 ^a	1.43±0.20 ^a	1.29±0.13 ^a	1.36±0.17 ^a
Equivalent diameter (mm)	4.17±0.15 ^b	4.39±0.23 ^a	3.94±0.11 ^c	4.19±0.18 ^b	2.91±0.17 ^d
Sphericity (%)	80.36±5.71 ^{ab}	80.16±4.36 ^{ab}	78.88±5.87 ^b	84.23±5.77 ^a	81.75±7.30 ^{ab}
Aspect ratio	0.73±0.10 ^a	0.73±0.07 ^a	0.72±0.11 ^a	0.78±0.08 ^a	0.74±0.09 ^a
Seed volume (mm ³)	26.81±2.49 ^b	30.72±4.16 ^a	22.94±2.05 ^c	27.77±2.59 ^b	11.30±1.51 ^d
Surface area (mm ²)	49.07±4.24 ^b	54.20±7.34 ^a	43.32±6.14 ^c	49.98±5.08 ^{ab}	23.89±3.84 ^d
Bulk density (Kg/L)	0.82±0.02 ^{ab}	0.82±0.03 ^{ab}	0.81±0.02 ^{ab}	0.80±0.01 ^b	0.85±0.01 ^a
True density (Kg/L)	1.29±0.03 ^a	1.30±0.05 ^{ab}	1.23±0.03 ^c	1.24±0.02 ^{bc}	1.33±0.01 ^a
Porosity (%)	36.94±0.09 ^a	36.94±0.08 ^a	33.82±0.56 ^c	35.58±0.12 ^b	35.88±0.06 ^b
100 seed mass (g)	5.72±0.25 ^{ab}	6.12±0.36 ^a	5.70±0.15 ^b	5.93±0.12 ^{ab}	2.80±0.15 ^c
100 seed volume (ml)	9.00±1.40 ^a	6.87±0.30 ^b	9.07±0.30 ^a	7.87±0.11 ^{ab}	2.80±0.20 ^c

Means within a column with different letters are significantly different ($p \leq 0.05$)

Cooking properties

Hydration capacity determines the extent to which seeds absorb water on soaking. Hydration capacity and hydration index varied significantly among the varieties and were observed in the range of 0.02-0.06g/seed and 0.80-1.06, respectively. Swelling capacity and swelling index varied from 0.052 to 0.160 ml/seed and 1.52-2.02, respectively. Swelling capacity of *Pinnamun* was significantly different from all others and it had the lowest compared to all others. Cooking time of mungbean cultivars without prior soaking varied significantly ($p \leq 0.05$) from 24.23 to 32.60 min. The lowest cooking time was found in *Pinnamun*. Cooking time after 12 h and 6 h soaking varied within 6.93-8.34 min and 7.53-9.34 min, respectively.

Nutritional composition of mungbean

The proximate composition values of mungbean are presented in Table 2. Protein content varied significantly from 19.2% to 26.6%, where MI5, MI6 and *Pinnamun* contained significantly higher protein content compared to MIMB 128. Ash content was observed in the range of 4.11-5.37% and it varied significantly ($p \leq 0.05$) among the cultivars. Fat content of mungbean was in the range of 5.00-5.64% and it did not vary significantly. The crude fiber content varied significantly from 5.0% to 5.6%.

Table 2. Composition and colour of mungbean

Parameters	MI5	MI 6	MB48	MIMB128	<i>Pinnamun</i>
Moisture (%)	10.05±0.14 ^b	10.99±0.51 ^a	8.88±0.85 ^c	8.63±0.20 ^c	8.82±0.26 ^c
Protein (%)	26.00±0.27 ^{ab}	26.60±0.27 ^a	24.97±1.63 ^b	19.21±0.68 ^c	25.84±0.17 ^{ab}
Fat (%)	1.34±0.48 ^a	0.91±0.15 ^a	1.34±0.31 ^a	1.12±0.24 ^a	1.42±0.09 ^a
Ash (%)	4.78±0.48 ^{ab}	4.11±0.65 ^b	5.37±0.01 ^a	5.28±0.11 ^a	5.22±0.06 ^a
Crude fiber (%)	5.60±0.06 ^a	5.00±0.14 ^b	5.64±0.10 ^a	5.17±0.10 ^b	5.00±0.12 ^b
Carbohydrates (%)	62.23±0.77 ^b	63.37±0.76 ^b	62.67±1.79 ^b	69.23±0.83 ^a	62.51±0.28 ^b
Color	Green	Green	Green	Greenish Yellow	Green

Means within a column with different letters are significantly different ($p \leq 0.05$)

CONCLUSIONS

Mungbean varieties and lines used in this study had significant differences in composition except for the crude fiber content. Seed dimensions, sphericity and surface area were significantly different among the cultivars and indicate that there may be variations required in the processing equipment design. MI5, MI 6, MB48 and MIMB128 have significantly higher hydration and swelling capacity compared to *Pinnamun*. Soaking for 6 or 12 h prior cooking can reduce cooking time from three to four times than cooking without soaking.

REFERENCES

- Adebowale, Y.A., A. Adeyemi and A. Oshodi. 2005. Variability in the physicochemical, nutritional and anti nutritional attributes of six *Mucuna* species. *Food Chemistry*. 89: 37 - 48.
- AgStat. 2016. Pocket hand book of agricultural statistics. Department of Agriculture, Peradeniya, Sri Lanka: 18-22.
- AOAC. 2000. Official Methods of Analysis, 17th Ed. Association of official Analytical chemists, Washington, DC: 141-144.
- AOAC. 2012. Official Methods of Analysis, 18th Ed. Association of official Analytical chemists, USA: Gaithersburg, Md: 101-105.
- Mohsenin, N. N. 1970. Physical Properties of Plant and Animal Materials. Gordon and Breach Science Publishers, New York, USA: 79-110.
- Rizvi, S.S.H. and G.S and Mittal. 1997. Experimental methods in food engineering. CBS Publisher & Distributor, New delhi: 435-448.