

Chemical Composition of Some Legumes

G. S. NIRANJAN and S. K. KATIYAR

Organic Chemistry Department, D. V. (P. G.) College, Orai (U. P.) India

Manuscript received 29 August 1977, revised 27 March 1978, accepted 23 May 1978

Five non-edible wild leguminous seeds were analysed for their comparative study of the chemical composition and free amino acids composition. The distribution of essential amino acids, from hydrolysates of albumin and globulin were studied. Tryptophan, cystine and methionine invariably appear to be the most common limiting amino acids in most of the seeds. No single seed has been found to be nutritionally complete with respect to essential amino acid content.

It has been reported by Patwardhan and Ramchandran¹ that the diet surveys made in India before and after the World War II showed that more than 75% of the total protein in the diet of the average man was derived from vegetable origin. The seeds of leguminous plants are the chief source of proteins in dietary system of India². Many such wild and uncultivated plants grow luxuriantly because of favourable soil and climate conditions³.

Though lot of research work has been carried out in India and abroad on the different leguminous plants, the present communication deals with a comparative chemical composition of biological importance of five non-cultivated leguminous seeds, *Cassia tora*, *C. fistula*, *C. occidentalis*, *Mucuna pruriata* and *M. capitata* of Bundelkhand region of central India.

Materials and Methods :

The experimental legumes were collected locally and botanically identified. The seeds were cleaned and powdered in a grinder to 100 mesh. Nitrogen was determined by the micro Kjeldahl method. Moisture and ash were estimated according to the method of A.O.A.C.⁴. Phosphorus and iron were estimated colorimetrically⁵. Etheral extractives and crude fibre value was determined by usual methods.

The amount of carbohydrate was calculated by determining the percentage of crude protein, crude fat, crude fibre and ash on a moisture free basis which are totaled and subtracted from 100⁷.

The amino acid composition of protein hydrolysates (albumin and globulin)⁸ of all experimental seeds were studied by paper partition-chromatography⁹ using Whatman No. 1. filter paper. The two dimensional technique of Datta et al¹⁰ with phenol (80%, w/v) NH₃ and butan-1-ol-acetic acid-water (4 : 1 : 5, v/v) as developing solvents were employed. In this method the known volume (2-3 ml) of protein hydrolysates were applied on filter paper sheets (30 × 30 cm) in triplicate and dried well after development. One was sprayed with ninhydrin (0.1% w/v) in butanol to predetermine the location of the different amino acids. This

provided guidance and different amino acids from the other unsprayed chromatograms were cut carefully and dropped in stoppered glass tubes, to which were then added distilled water (1 ml), acetate-cyanide buffer (0.5 ml) and ninhydrin (0.5 ml, 0.5% w/v) in methyl cellosolve. The tubes were heated in a water bath at 100° for 15 minutes and diluted by the addition of a 2-propanol-water mixture (5 ml, 1 : 1 v/v). The contents of the tubes were thoroughly mixed and cooled to room temperature 23° and colour density was measured in a colorimeter at 570 m μ for all amino acids except proline which was measured at 440 m μ along with blank and standard glycine solution. Determinations were made in triplicate and the amount of each amino acid was calculated in terms of glycine as shown in Table 2.

Results and Discussion

Table 1 clearly shows that the noted inedible leguminous seeds contained higher percentage of crude protein (23-36), fat and essential minerals suggesting their possible inclusion in animal nutrition.

TABLE 1—CHEMICAL COMPOSITION OF SOME INDIAN LEGUMES

Constituents	Leguminous seeds				
	<i>Cassia fistula</i>	<i>Cassia tora</i>	<i>Cassia occidentalis</i>	<i>Mucuna pruriata</i>	<i>Mucuna capitata</i>
1. Moisture (%)	5.95	4.48	8.74	9.09	7.75
2. Ash (%)	3.00	7.34	6.10	3.38	3.46
(a) Water soluble ash	25.00	10.44	53.1	3.87	28.38
(b) Acid soluble ash (N × 6.25)	51.1	78.2	89.7	85.7	66.99
3. Fat (ether-extractives)	1.61	2.74	4.62	3.48	2.9
4. Crude protein (N × 6.25)	31.00	23.77	26.25	31.87	35.6
5. Minerals					
Iron (g/100 g)	0.234	0.187	0.156	0.781	0.155
Inorganic phosphorous (mg/100g)	68.825	361.7	174.47	185.23	93.612
6. Crude fibre	13.08	13.14	4.2	12.84	14.94
7. Carbohydrate	45.36	48.53	50.09	38.50	35.35

TABLE 2—ESSENTIAL AMINO ACID CONTENT OF SOME NON-CULTIVATED LEGUMINOUS SEEDS :
(Expressed as mg glycine per 100 mg protein)

Amino Acid	Albumin Seed*					Globulins Seed*				
	1	2	3	4	5	1	2	3	4	5
1. α -alanine	1.4	1.3	1.6	1.6	1.7	3.3	4.0	3.6	3.6	3.8
2. Arginine	2.4	1.9	1.6	2.8	2.0	3.5	3.3	3.7	3.6	3.1
3. Aspartic ac'd	6.2	8.0	7.4	6.9	6.8	4.8	3.7	3.5	3.5	3.2
4. Cysteic acid	0.2	0.6	0.4	0.9	0.8	0.3	—	0.6	0.2	0.2
5. Glutamic acid	4.6	5.7	5.0	4.8	5.0	5.0	5.1	8.6	8.3	8.3
6. Glycine	1.3	1.2	1.1	1.5	0.2	2.1	2.2	2.0	2.5	2.8
7. Histidine	2.0	1.0	1.3	1.0	2.2	1.6	1.8	1.5	1.3	1.2
8. Leucine and isoleucine	5.1	6.2	6.6	5.8	2.4	6.1	6.0	6.2	6.2	5.2
9. Lysine	3.6	4.7	4.2	3.8	2.0	2.8	2.8	4.0	3.0	2.4
10. Methionine	0.1	—	0.2	—	—	0.4	0.5	0.2	—	—
11. Proline	1.8	1.5	1.4	1.0	1.2	0.4	0.2	0.2	0.2	0.1
12. Phenylalanine	1.6	1.4	1.2	2.2	1.0	2.0	2.8	2.2	2.1	2.0
13. Serine	1.0	1.2	1.4	1.5	1.8	2.0	2.6	4.2	3.6	3.7
14. Threonine	2.6	2.6	2.5	4.8	4.5	1.2	1.2	1.0	2.4	2.4
15. Tryptophan	—	—	+	—	—	—	—	+	—	—
16. Tyrosine	1.2	1.2	0.8	0.9	0.8	0.2	0.7	1.2	0.9	0.9
17. Valine	2.2	2.0	1.6	2.0	1.8	2.6	2.8	2.2	3.0	3.0

* Seeds 1 = *Cassia tora*, 2 = *Cassia occidentalis*, 3 = *Cassia fistula*, 4 = *Mucuna prurita*, 5 = *Mucuna capitata*.

+ = Present quantity not determined.

— = Absent.

The amino acid composition of leguminous seed proteins compare very well with one another. All the seed proteins comprise 15-17% amino acids. Globulins from seed 3 is nutritionally complete protein, since it contains all the essential amino acids known for biological importance. Globulins 1,2,4 and 5 lack only tryptophan while 4 and 5 have the absence of methionine as well. Glutamic acid, leucine, isoleucine and aspartic acid concentration predominate over the other amino acids.

Albumins 1,2,4 and 5 lack tryptophan, while 2,4 and 5 lack methionine, whereas albumin 3 is nutritionally complete protein. Generally the albumin content in the seeds are smaller than globulin, their contribution in the diet is questionable. Both the proteins are found to be deficient in methionine and tryptophan and globulin from seed 2 lack cysteic acid. Table 2 shows that the amino acid composition of seeds 1,2,3,4 and to some extent 5 are very much similar. This observation is suggestive of a taxonomic relationship among seeds of *Cassia* species and *Mucuna* species. Furthermore the seeds of *Mucuna* species (particularly *Mucuna prurita*) have approximately same (in some cases quite larger) amount of essential amino acids in comparison to seeds of *Cassia* species. The concentration of glutamic acid is in general higher in the globulins than in albumins which are significantly richer in aspartic acid concentration as shown in the Table 2.

Acknowledgement

The authors wish to thank Dr. B. B. Lal, Principal, D. V. (P. G.) College, Orai (U. P.) for providing necessary facilities and are grateful to State Council of Science and Technology, Lucknow (U. P.) for financial assistance.

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