Biochemistry/Nutrition

Amino Acid Composition and Protein Content of Chickpea and Its Wild Relatives

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Chickpea (*Cicer arietinum*) is one of the most important grain legumes used for human food and animal feed. Like other grain legumes, it is a rich source of dietary protein. Seed protein content in diverse chickpea germplasm accessions and commonly grown cultivars ranged between 12.5 and 31.5% (Williams and Singh 1987). However, this review did not report a large variability in the essential amino acids of chickpea seed. At ICRISAT, besides improving productivity and yield stability of chickpea, efforts have been concentrated on improving the protein quality by using the available high protein sources of cultivated species of chickpea (Kumar et al. 1982). The wild species of chickpea can also be considered as relevant donor parents for this purpose. We have studied the amino acid composition and protein content of some available wild relatives of chickpea. The results of this study are summarized in this paper.

Seed samples for this study were obtained from the chickpea germplasms grown on Vertisol fields at ICRISAT Center during 1985. As a basal fertilizer dose, 20 kg N and 40 kg P ha^{-1} were applied and two protective irrigations were provided during the crop season. Dhal samples were prepared and used for analysis. Protein content was determined by using the procedure of Technicon Auto Analyzer (Singh and Jambunathan 1980). The amino acid profiles of the dhal samples were determined using a Beckman 119-CL amino acid analyzer.

More than one accession were analyzed for *C. reticulatum*, *C. judaicum*, *C. bijugum*, *C. pinnatifidum*, and *C. yamashitae*, and their mean values have been reported (Table 1). In general, the amino acid composition of various wild species were comparable with that of a cultivated species (cv G 130).

Like other grain legumes, chickpea is considered a rich source of lysine. We noticed no large differences in lysine content in the cultivated and wild species (Table 1). The quality of a protein is primarily estimated by comparing its amino acid composition with that of a standard

Table 1. Amino acid composition [g $(100g)^{-1}$] and protein content of dhal samples of some wild species of chickpea.

Amino acid	Control G 130 (n[1]=1)	*C. reticulatum* (n=6)	*C. judaicum* (n=4)	*C. bijugum* (n=4)	*C. pinnatifidum* (n=3)	*C. yamashitae* (n=2)	*C. cuneatum* (n=1)	*C. echinospermum* (n=1)
Lysine	6.4	6.1	6.4	6.2	5.7	6.7	6.5	6.1
Histidine	2.8	2.9	2.9	2.9	2.7	2.9	3.0	2.9
Arginine	9.4	9.9	9.0	10.3	9.0	9.2	7.7	9.8
Aspartic acid	10.4	10.3	11.0	10.4	9.1	10.8	10.5	10.3
Threonine	3.0	3.2	3.3	3.2	2.8	3.5	3.6	3.3
Serine	4.4	4.4	4.4	4.3	3.5	4.7	4.5	4.4
Glutamic acid	15.7	14.8	16.0	14.7	14.7	16.3	15.4	14.7
Proline	3.8	3.9	3.9	3.9	3.6	4.1	4.1	3.9
Glycine	3.7	3.5	3.7	3.4	3.4	3.8	3.7	3.5
Alanine	3.7	3.8	3.8	3.6	3.8	4.2	4.0	3.8
Cystine	1.1	1.2	1.2	1.5	0.9	1.1	1.1	1.2
Valine	4.2	4.0	4.1	3.9	3.9	4.3	4.2	4.0
Methionine	1.8	1.4	1.2	1.3	1.2	1.4	1.3	1.2
Isoleucine	4.0	4.1	4.5	4.2	3.9	4.6	4.4	4.2
Leucine	7.0	6.6	7.0	6.6	6.4	7.3	7.0	6.6
Tyrosine	2.9	2.9	3.1	2.9	2.8	3.1	3.0	3.0
Phenylalanine	5.2	5.1	6.0	5.6	5.2	5.8	5.6	5.3
Protein[2] (%)	25.2	30.6	29.9	32.7	29.7	26.5	30.3	29.4

1. n = number of accessions analyzed for each species and mean value reported where more than one accession analyzed.
2. Results expressed on a moisture free basis (N × 6.25).

reference protein, the most limiting amino acid determining the nutritive value. By applying this procedure, the sulfur-containing amino acids methionine and cystine, are the first limiting amino acids in chickpea. When considered together, methionine and cystine varied from 2.1 to 2.8 g $(100g)^{-1}$ protein for all wild species accessions analyzed, whereas it was 2.9 g $(100g)^{-1}$ protein for G 130. This indicated that sulfur-containing amino acids are higher in the cultivated species than in the wild species. This might have been due to the highest level of methionine [1.8 g $(100g)^{-1}$ protein] in G 130. Next to sulfur-amino acids and tryptophan, threonine and valine emerge as the most important amino acids, since the chemical score for these amino acids was generally below the satisfactory level in chickpea (Williams and Singh 1987). Threonine and valine values did not show a large variation among the cultivated and wild species of chickpea (Table 1). Tryptophan was not analyzed in the present study as it was destroyed during acid hydrolysis.

The total seed protein content of wild species was considerably higher than in G 130 (Table 1). When expressed on moisture-free basis, among wild species the protein content of *C. bijugum* was the highest (32.7%) and of *C. yamashitae* the lowest (26.5%). The protein content of G 130 was 25.2%. The wild species, *C. bijugum* and *C. reticulatum* can be considered as relevant donor parents for the transfer of high seed protein trait to the cultivated chickpea. These species are good sources of resistance to various diseases, insect pests and cold (van der Massen and Pundir 1984 and ICARDA 1989). They also possess reasonably good seed size (100-seed mass > 9 g) compared to the very small seed size (100-seed mass about 2 g) of most of the remaining wild *Cicer* species. Therefore, efforts need to be initiated to utilize wild *Cicer* species in developing high protein chickpea cultivars.

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Entomology

Monitoring of *Helicoverpa armigera* (Hübner) in Pakistan with Pheromone Traps

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Helicoverpa armigera is a major pest of chickpea in Pakistan and has been reported to cause 40–50% pod damage (Virmani et al. 1991).

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) in collaboration with the Pakistan Agricultural Research Council (PARC) developed a network of *H. armigera* pheromone traps in different agroecological zones of Pakistan in 1983. The main objective of this network was to monitor *H. armigera* moths in different agroecological zones to determine the maximum threat periods to chickpea. As *H. armigera* is an important pest of chickpea in Pakistan, the monitoring of this insect was carried out during the growing season of chickpea. Almost all the cooperators who operated the traps on research farms were agricultural entomologists associated with the pulses program of The National Agricultural Research Center (NARC), Pakistan.