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Free Amino Acids and Protein in Seeds of *Vicia faba*

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By paper chromatography seeds of 16 cultivars of *Vicia faba* were examined for free amino acids and protein. Cultivars differed in quality and quantity of free amino acids, but arginine, aspartic acid, iso-leucine, leucine, methionine, phenylalanine, serine and valine were common to all. Total protein varied from 19% (Dh. B-26) to 33% (Dh. B-11 (ii)).

Key Words: *Vicia faba*, Cultivars, Amino acids, Aminogram, Protein.

The legume *Vicia faba*, commonly known as the broad bean is under extensive cultivation throughout the world for its high protein value. It is one of the major crops used as a pulse and vegetable in Afro-Asian countries and in the north-eastern region of India. Basson (1965) and Pernollet & Mosse (1980) reported intraspecific and phenotypic variations of amino acid composition and protein content in legume seeds. The aminogram and a knowledge of the protein content are important parameters in the selection of cultivars for large scale cultivation. We screened seeds of 16 cultivars of *V. faba* for amino acids and protein.

MATERIALS & METHODS Seeds were obtained from the Agriculture-cum-Research Farm, Rajendra Agricultural University, Dholi (Pusa, Bihar) and multiplied in the experimental garden of the Botany Department. Two dimensional paper chromatographic technique was used for separation and identification of different amino acids and the method used by Rajan & Laloraya (1960) was followed for extraction. Three replicates were used. Protein was estimated using Oser's (1965) method. Three samples of randomly selected seeds were weighed and processed for protein extraction.

RESULTS & DISCUSSION **The data on aminogram and protein content are presented in Tables 1 & 2, respectively. About 28 ninhydrin positive spots in different cultivars were separated. Eight unidentified spots, on the basis of Rf values of known amino acids, could possibly be non-protein amino acids (Bell, 1980b). These amino acids sometimes affect the quality of protein because some of them resemble protein amino acids and get attached during protein synthesis. According to Bell (1980 a,b) they deter grazing by animals. Maximum number of these amino acids was observed in Dh. B-18 whereas none was present in Dh. B-12. In Dh. B-16, a unique spot was observed (Table 1). Among the 20 amino acids, 8 were common to all the cultivars, but they showed quantitative variation.**

The total protein content (calculated by multiplying the value of N% with 6.25) in different cultivars ranged from 19% in Dh. B-26 to 33% in Dh. B-11 (ii). Average weight of 10 seeds varied from 2.11 g (Dh. B-18 and Dh. B-26) to 3.75 g (Dh. B-16 and Dh. B-11 (ii)) (Table 2).

Studies dealing with intraspecific variation of amino acid composition in legume seeds are relatively few. Busson (1965) initiated this study in *Arachis hypogaea*, *Lablab niger*, *Glycine max* and *Kerstingiella geocarpa*. Since then several species have been analysed at intraspecific level, e.g. *Lens culinaris* (Bhatty *et al.*, 1978), *Phaseolus lunatus* (Busson, 1965; Evans & Boulter, 1974; Maneepun *et al.*, 1974), *Vigna unguiculata* (Otoul 1973; Bliss, 1975), *Pisum sativum* (Holt & Sosulski, 1979).

Table 1 Amino acids in cultivars of *V. faba*

CULTI -VAR	AMINO ACIDS																												
	Ala	Amino but.	Arg	Asp	Cys	Glu	Gly	His	Ileu	Leu	Lys	Met	Orn	Phe	Pro	Ser	Thr	Try	Tyr	Val	Un-identified							
																					1	2	3	4	5	6	7	8
Db.B-1	–	–	+	+ + +	–	+	+	+ +	+	+	+ +	+ + +	–	+	+	+	–	+	+	+ +	–	+	–	–	–	–	–	–
Db.B-3	+	+	+ +	+ +	+ + +	+ + +	–	+	+	+	+	+	+	+	–	+	+ + +	–	+ + +	+	+	–	+	+	+	–	–	–
Db.B-4	+ +	+	+ +	+ +	+	+	+	+	–	+	+	+	+ + +	+ + +	–	+	+	–	+	+ + +	–	+	–	–	–	+	–	–	–
Db.B-5	+ +	+	+ +	+	+	–	+	–	+	+	–	+	–	+	–	+ +	–	+ + +	–	+ + +	–	+	+	–	+	–	–	–	–
Db.B-6	–	–	+ +	+	–	–	+ +	+ +	+	+	+	+ + +	+	+ + +	–	+	+	+ +	+	+	–	–	–	–	+	+	+	–	–
Db.B-7	+ +	–	+ + +	+	+	+	+	–	+	+ + +	–	+	+	+	–	+ +	–	–	+ + +	+ + +	–	+	–	–	+	+	–	–
Db.B-10	+	+	+	+ +	+ +	+	–	+	+ +	+	+	+	+ +	+	+	+ +	–	+ +	–	+ +	–	+ +	+ +	–	–	–	–	–
Db.B-5(3)	–	–	+ +	+ + +	–	+ +	–	+	+	+ +	–	+ +	–	+	–	+ +	+ +	+	–	+	–	–	–	–	–	+ +	–	–
Db.B-8 (3)	–	–	+ + +	+ + +	+	+	+ +	+ +	+	+ +	+	–	+ +	+ +	–	+	+	+ + +	+	+ + +	+	–	+ +	–	–	–	–	–	+
Db.B-12	+ + +	+ + +	+	+ +	+ + +	+ + +	–	+ +	+ +	+	–	+	–	+ +	–	+	–	–	–	+ +	–	–	–	–	–	–	–	–
Db.B-16	+	+	+ + +	+	+ + +	–	+	+ +	+ +	+ + +	+ +	+ +	–	+	–	+ +	+ +	+ + +	–	+ +	–	–	–	–	–	–	+	–
Db.B-17	–	+ + +	+	+ + +	+ +	+ + +	+	+	+	+	+ +	+ +	–	+	–	+	–	–	+ +	+ +	–	+	–	–	+	–	–	–
Db.B-18	+ +	+ + +	+	+ +	+ + +	+	–	+	+ + +	+ +	–	+	–	+	–	+	+ +	+ + +	+	+ + +	+ +	–	+	+	–	+ +	–	+
Db.B-19	–	+	+ + +	+ + +	+ +	–	–	+ +	+	+	–	+	–	+ +	–	+	–	–	–	+ +	–	+	–	+	–	–	–	+
Db.B-23	+ + +	+	+ + +	+ + +	+	+ + +	+	+	+ +	+	–	+	+ +	+	–	+	–	–	–	+	–	–	–	–	+	–	–	–
Db.B-26	+	+ +	+ +	+ + +	+	+ +	+	+	+	+	+ +	+ +	+ +	+ +	+ +	+ +	–	+	–	+ +	–	–	–	+	+	–	–	–

+ = below 3 μg; + + = between 3 to 7.5 μg; + + + = between 7.5 and 14.5 μg; – = Untraceable. Amounts calculated μg per gm seed weight.

Table 2 Protein content and seed wt. of *Vicia faba* cultivars

Cultivar	Protein(%)	Seed Weight (g) per 10 seeds (2)
Dh. B-1	24 ± 0.48	2.31
Dh. B-3	31 ± 0.09	3.25
Dh. B-4	32 ± 0.78	3.70
Dh. B-5	26 ± 0.86	3.00
Dh. B-6	27 ± 1.02	3.19
Dh. B-7	31 ± 0.80	3.70
Dh. B-10	27 ± 0.87	3.15
Dh. B-11 (i)	22 ± 0.92	2.65
Dh. B-11 (ii)	33 ± 0.08	3.75
Dh. B-12	31 ± 0.81	3.56
Dh. B-16	30 ± 0.68	3.75
Dh. B-17	29 ± 0.77	2.90
Dh. B-18	27 ± 1.04	2.11
Dh. B-19	39 ± 1.30	3.21
Dh. B-23	26 ± 0.73	2.15
Dh. B-26	19 ± 0.66	2.11

± = S. D.

Higher protein content was correlated with lower level of lysine and methionine and a high value of arginine and typtophan (Tables 1 & 2). Similar conclusions were drawn by number of workers (Mosse & Baudet, 1977; Eppendorfer & Bille, 1974; (Holt & Sosulski 1979). However, in Dh. B-16 and Dh. B-17, protein content was not accompanied by any marked decline in lysine and methionine. Such cultivars, containing high protein and lysine could serve as useful materials for breeding programme.

The difference of mean protein content between Dh. B-11 (ii) and Dh. B-4 was not significant at 5% level of significance (one tailed test) and that of Dh. B-11 (ii) and Dh. B-4, Dh. B-7, Dh. B-12 and Dh. B-19 were not significant at 1% level of significance (one tailed test). Clearly Dh. B-11 (ii) was superior to other cultivars except Dh. B-4 at 5% level and Dh. B-4, Dh. B-7, Dh. B-12 and Dh. B-19 at 1% level.

REFERENCES

BELL E A 1980a A possible significance of secondary compounds in plants, in: Secondary Plant Products (Encyclop Plant Physiol. New Ser.) Springer-verlag, (Berlin) pp 11-22

BELL E A 1980b Non protein amino acids in plants, in: Secondary Plant Products (Encyclop Plant physiol. New Ser.) Springer-verlag, Berlin pp 403-432.

BHATTY R S, S E SLINKARD & F W SOSULSKI 1978 Chemical composition and protein characteristics of lentils, *Can J Plant Sci* **56** 787-794.

BLISS F A 1975 Cowpea in Nigeria, in M. Milner (Ed) **Nutritional Improvement of food legumes by Breeding,** Wiley, New York pp 151-158

BUSSON F 1965 Plant alimentaires de l Quest africain, E tude botanique biologique et chimique, *Min. Coop. Rech. Sci and Techn et Armees Chemistry and biochemistry of of legumes* **pp** 111-193.

EPPENDORFER W H & S W BILLE 1974 Amino acid composition as a function of total N in pea seedes grown on two soils with P and K additions, *Plant Soil* **41** 33-39

EVANS I M & D BOULTER 1974 Amino acid composition of seed meals of yam bean (*Sphenostylis stenocarpa*) **and lima bean** *Phaseolus lunatus*), *J. Sci. Food Agr.* **25** 919-922

HOLT N W & F W SOSULSKI 1979 Amino acid composition and protein quality in field peas, *Can. J. Plant Sci.* **59** 653-660.

MANEEPUN S, B S Luh & R B Becker 1974 Amino Acid Composition and biological quality of lima bean protein, *J. Food Sci.* **39** 171-174.

MOSSE J & J BAUDET 1977 Relationship between amino acid composition and nitrogen contents of broad bean seed. In: Protein Quality from Leguminous Crops. Commission of the European Communities, Corroboration of agricultural research EUR 5686 E N pp 48-56.

OSER B L 1965 Blood Analysis in Hawk's Physiological Chemistry, Mc Graw Hill, New York pp 975-1172.

OTOUL E 1973 Variabilite due spectre des acides amines chez *Vigna unguiculata* (L) Walp, *Bull Rech Agron Gembloux* 8 pp 124-134.

PERNOLLET J C & J MOSSE 1980 Characterisation des corpuscles proteiques de l'albumen des caryopses de cereales par microanalyse electronique a balayage, *C R Acad Sci Paris* 290 267-270.

RANJAN S & M M LALORAYA 1960 Metabolism of isolated leaves I changes in protein, soluble nitrogenous compounds, sugars and organic acids in tobacco leaves in light and dark, *Plant Physiol* 35 714-725.