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SYSTEMATIC VARIATION IN LEAF AMINO ACID COMPOSITIONS OF LEGUMINOUS PLANTS

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Key Word Index—Leguminosae, leaf amino acids, systematic variation

Abstract—The leaf protein content for 17 species of legumes ranges from 2 8 to 9 4 g % fr wt, with an average of 5 3 g % fr wt Taxonomic pattern is detectable in leaf amino acid patterns, those of the Mimosoideae being distinguishable from those of the Papilionoideae and Caesalpinioideae

INTRODUCTION

Analyses of available data on seed amino acid compositions of legumes have shown variations consistent with grouping of the Leguminosae into the subfamilies, Mimosoideae, Caesalpinioideae and Papilionoideae [1, 2] There is also evidence of correlation between viral susceptibility and taxonomic groupings in the case of certain legume hosts [3] In dicotyledonous plants, amino acid compositions of leaves have yielded taxonomic distinctions between groupings, e g between caryophylloids, legumes and acanthoids [4] while in a monocotyledonous family, the Poaceae, the existence of taxonomic pattern in the amino acid compositions of leaves, caryopses and ribulose-1,5-bisphosphate carboxylase, has also been demonstrated [5–7] As part of our continuing effort to understand the taxonomic predictability of protein amino acid compositions of plants, it seemed worthwhile to examine the Leguminosae to discover whether taxonomic pattern can be detected in the leaf aminó acid compositions of a dicotyledonous family, and whether the legume pattern is distinguishable from that of the grasses [7] This paper presents the amino acid analyses of leaves from 17 species of legumes, representing all three subfamilies [8]

RESULTS AND DISCUSSION

Leaf protein content for the 17 species of legumes studied showed large variation, ranging from 2 8 g % fr wt in *Tamarindus indica* to 9 4 g % fr wt in *Bauhinia purpurea* (Table 1) Comparisons at subfamily level do not show any taxonomic correlation in the distribution pattern of leaf protein content, the mean protein content in the Mimosoideae (5 2 g % fr wt), Caesalpinioideae (5 3 g % fr wt) and Papilionoideae (5 6 g % fr wt) being closely similar

Variations in the leaf amino acid compositions for the 17 species of legumes are given in Table 1 Of these, *Mimosa pudica* and *Bauhinia purpurea* are interesting in that they have yielded the highest level of Leu (13.8 %) and Asp (16 0 %) respectively Comparisons of the three subfamilies show that the Mimosoideae pattern is distinguishable from that of the Papilionoideae by its significantly higher (at 5 % probability level) Glu and His and lower Asp and Thr, and from the Caesalpinioideae by its significantly higher Glu and His and lower Thr and Phe content (Table 1) The amino acid profiles of the Caesalpinioideae and Papilionoideae do not show any significant differences at the 5 % probability level although some amino acid values of the Caesalpinioideae (such as Asp, Glu, Met and His) occupy an intermediate position between the Mimosoideae and the Papilionoideae Although the sample of species is small, this result is consistent with taxonomic schemes which place the Papilionoideae closer to the Caesalpinioideae than to the Mimosoideae [3, 8].

Comparison of the legume leaf amino acid patterns with those of grasses [7] shows that they are clearly distinguishable, the legumes having yielded significantly higher levels of Asp, Pro, Tyr, Phe, His and Arg and lower levels of Ser and Ala These observations seem to support the suggestion that a systematic survey of a wide range of plant groups may reveal predictable leaf protein amino acid compositions [4, 7]

EXPERIMENTAL

Plant materials Leaf samples were collected from plants grown in the garden of the Botany Department, National University of Singapore, the Singapore Botanic Gardens and elsewhere in Singapore Their identities were checked with reference to regional floras and voucher specimens have been deposited in the National University of Singapore Botany Department Herbarium

Preparation for amino acid analysis Leaf blades of mature and healthy leaves were finely cut and 100–200 mg material was hydrolysed in 0 5 ml 3 N mercaptoethanol sulphonic acid in a sealed tube at 110° for 22 hr [7] After hydrolysis, 0 5 ml 2 N NaOH was added to the sample which was then diluted with 2 ml distilled water The sample (100 μl) was then analysed on a Beckman amino acid analyser 119CL Duplicate analyses representing collections from different plants of the same species carried out for some species showed some variations (see Table 1) Such variations among individuals of the same species have been observed in our earlier studies [7] but so far they have not affected significantly the taxonomic conclusions. For subsequent

Table 1 Total leaf amino acid compositions of legumes

Species	Amino acid compositions (g% total amino acids)																	Total amino acids (g% fr wt)
	Asp	Thr	Ser	Glu	Pro	Gly	Ala	Val	Met	Ile	Leu	Tyr	Phe	His	Lys	Trp	Arg	
Mimosoideae																		
Acacia auriculiformis A Cunn ex Benth	121	51	63	150	63	51	58	46	20	30	89	45	54	30	80	01	43	359
Acacia auriculiformis A Cunn ex Benth	120	48	58	150	68	54	58	46	21	33	88	49	58	31	73	00	45	308
Adenanthera pavonina L	119	52	52	130	61	59	63	52	19	37	92	56	63	29	66	00	48	745
Albizia falcataria (L) Fosberg	119	48	57	146	74	53	60	45	19	34	92	49	58	26	75	01	45	446
Mimosa pudica L	126	49	47	134	57	71	58	47	21	33	138	48	54	25	44	00	48	702
Parkia javanica (Lamk) Merr	121	49	51	139	70	66	57	49	18	37	92	54	63	28	62	00	44	352
Taxonomic mean value	121	50	54	140	66	60	59	48	20	35	100	51	58	28	65	00	46	516
Caesalpinioideae																		
Bauhinia purpurea L	160	53	48	119	60	65	51	48	16	35	105	55	63	24	53	03	44	943
Cassia biflora Griseb	127	57	56	131	59	56	62	48	21	37	90	53	61	23	69	01	49	542
Cassia biflora Griseb	122	55	52	125	59	58	68	48	22	36	100	52	65	24	67	01	46	532
Delonix regia Rafin	128	61	59	134	68	37	68	48	21	35	86	52	63	26	67	01	47	565
Saraca thaipingensis Cantley ex Prain	125	49	52	108	76	56	62	43	17	33	96	61	68	24	90	01	40	332
Tamarindus indica L	118	51	56	127	68	56	62	47	20	36	96	51	61	24	80	02	45	275
Taxonomic mean value	131	54	54	123	66	54	62	47	19	35	96	54	64	24	71	02	45	530
Papilionoideae																		
Baphia nitida Afzel	122	53	59	124	76	53	61	47	17	34	109	52	60	26	62	01	44	631
Crotalaria retusa L	140	55	49	134	58	57	61	51	18	36	92	50	59	28	60	03	47	309
Desmodium triflorum (L) DC	134	53	52	131	59	55	59	54	18	37	91	52	62	27	71	00	45	580
Millettia atropurpurea Benth	124	51	59	130	77	57	60	50	18	38	89	50	59	22	75	00	41	424
Psophocarpus tetragonolobus (L) DC	124	58	51	123	56	54	66	49	18	37	110	55	62	23	66	01	47	660
Psophocarpus tetragonolobus (L) DC	121	57	51	125	58	54	67	47	20	35	114	54	61	25	65	02	46	674
Pterocarpus indicus Willd	129	59	60	119	74	53	59	49	15	38	93	56	68	25	63	01	39	647
Sesbania grandiflora Pers	153	55	48	141	54	54	57	47	17	34	91	52	61	21	65	04	48	642
Taxonomic mean value	132	55	54	129	65	55	61	49	18	36	97	52	61	25	66	02	43	557

taxonomic mean calculations mean values of duplicate analyses were used

Total leaf amino acids Total leaf amino acid contents were calculated from the amino acid analyses, and expressed as g % fr wt leaf samples

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