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Food value of lesser utilised tropical plants

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Protein contents, amino acid compositions and other nutritional and anti-nutritional factors in leaves of *Asystasia gangetica, Asystasia nemorum, Kaempferia galanga, Mentha arvensis* and *Piper sarmentosum* were determined. The analyses showed that these lesser utilised plants were rich in protein, had a good complement of amino acids, and a favourable amount of minerals, sugars, lipids and fibre. Furthermore, anti-nutritional factors, such as trypsin and chymotrypsin inhibitors, and cyanide, were not detected. Overall, these plants represented a potential food source with high protein content and good nutritive value.

INTRODUCTION

In Singapore many plants are consumed as vegetables or are used in food preparations only by certain ethnic communities; for example, the Malays and the Straits Chinese. Since knowledge of their use is usually transmitted by personal communication, they remain unknown to the general population. Four plant species known to fall into this category of lesser utilised vegetables are *Asystasia gangetica, Kaempferia galanga, Mentha arvensis* and *Piper sarmentosum*. These plants, which are occasionally sold in the markets, are also cultivated in home gardens for personal consumption. Except for *Asystasia* which is eaten cooked, the others are known to be eaten either raw or cooked. In Malaysia and Indonesia, the use of these plants as a food source by ethnic communities has been documented (Burkill, 1966; Ochse & Bakhuizen, 1977; Keng, 1983).

Although these plants are eaten as vegetables, their food values have never been assessed. In order to promote their use as food sources, information on their nutritional value is desired. In this context, we determined the protein content, the amino acid composition and other nutritional as well as anti-nutritional factors in the leaves of *Asystasia gangetica, Kaempferia galanga, Mentha arvensis* and *Piper sarmentosum*. We also included in this study *Asystasia nemorum*, a common weed that has shown potential as animal feed (Abdullah, 1985).

MATERIALS AND METHODS

Freshly harvested leaves (edible portions) were used for all analyses. The crude protein content was determined using the microKjeldahl technique (Bailey, 1967) with 50 mg dried leaf material. For amino acid analyses, leaf material was hydrolysed in sealed tubes in 3N mercaptoethane sulphonic acid at 110°C for 22 h according to Yeoh *et al.* (1986), then analysed using an LKB Plus 2 amino acid analyser. Moisture, soluble sugar, lipid, ash and dietary fibre contents, trypsin and chymotrypsin inhibitors were all determined as described in Bradbury & Holloway (1988). Starch and cyanide contents were determined following the methods described in Balagopalan *et al.* (1988). Component minerals were determined from ashed samples by the AOAC method (1984) using a Varian Model AA-30 atomic absorption spectrophotometer.

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RESULTS AND DISCUSSION

The proximate composition of the edible leaves of *A. gangetica, A. nemorum, K. galanga, M. arvensis* and *P. sarmentosum* is given in Table 1. For comparative purposes, values on a dry weight basis have also been included in Table 1. Moisture content formed the bulk of tissue weight. It ranged from 81 g% fr. wt in *P. sarmentosum* to 94 g% fr. wt in *K. galanga*. The energy value based on protein, lipid, starch and soluble sugar contents for these plants ranged from 118 kJ/100 g fr. wt in *K. galanga* to 321 kJ/100 g fr. wt in *P. sarmentosum*. The crude protein content was the lowest in *K. galanga* (1 g% fr. wt) compared to the others (protein content ranging from 3 to 4·6 g% fr. wt). Starch and total soluble sugars were low for all plants, usually less than 1 g% fr. wt. Lipid content, on the other hand, averaged 2 g% fr. wt except for *P. sarmentosum* (5·7 g% fr. wt). Dietary fibre content ranged from 1·3 g% fr. wt in *K. galanga* to 2·5 g% fr. wt for both *A. nemorum* and *M. arvensis*. Ash content ranged from 0·8 g% fr. wt in *K. galanga* to 2·3 g% fr. wt in *P. sarmentosum*.

Table 1. Proximate and mineral compositions of leaves of five lesser utilised tropical plants

Composition (g% fr. wt)	Plant species				
	A. gangetica	*A. nemorum*	*K. galanga*	*M. arvensis*	*P. sarmentosum*
Moisture	85·6	87·8	94·4	88·1	81·1
Energy (kJ)	182 (1 236)[a]	143 (1 173)	118 (2107)	147 (1 235)	321 (1 701)
Protein	4·6 (31·9)	3·0 (24·6)	1·0 (17·9)	3·2 (26·9)	4·0 (21·2)
Starch	0·7 (4·9)	0·9 (7·4)	0·5 (8·9)	0·8 (6·7)	1·3 (6·9)
Soluble sugar	0·3 (2·1)	0·3 (2·5)	0·3 (5·4)	0·2 (1·7)	0·9 (4·8)
Lipid	2·3 (15·0)	1·9 (15·6)	2·3 (41·1)	2·0 (16·8)	5·7 (30·2)
Dietary fibre	1·7 (11·8)	2·5 (20·5)	1·3 (23·2)	2·5 (21·0)	1·9 (10·1)
Ash	1·9 (13·2)	2·0 (16·4)	0·8 (14·3)	1·5 (12·6)	2·3 (12·2)
Minerals (mg/100 g)					
Ca	243 (1 686)	191 (1 566)	109 (1 947)	281 (2 360)	396 (2 099)
Mg	232 (1 610)	205 (1 681)	58 (1 036)	37 (311)	80 (424)
Fe	63 (437)	96 (787)	57 (1 018)	124 (1 042)	187 (991)
K	513 (3 560)	565 (4 633)	201 (3 589)	420 (3 528)	572 (3 032)
Cu	1·3 (9·0)	1·1 (9·0)	0·6 (10·7)	1·6 (13·4)	3·8 (20·1)

[a] Values in parentheses refer to values on a dry weight basis.

Differences were also observed in the mineral composition (Table 1). The leaves of *P. sarmentosum* exhibited the highest level of calcium (396 mg/100 g fr. wt), iron (187 mg/100 g fr. wt) and copper (3·8 mg/100 g fr. wt) while the two *Asystasia* species were rich in magnesium (205 and 232 mg/100 g fr. wt). *P. sarmentosum* and both *Asystasia* species were also rich in potassium, exceeding 500 mg/100 g fr. wt. Anti-nutritional factors, such as trypsin and chymotrypsin inhibitors and cyanide were not detected in the leaves of any of the plants studied.

The total leaf amino acid compositions of these plants were also determined (Table 2). Cluster analysis of the amino acid data showed both *Asystasia spp.* shared greater similarity in their amino acid profiles. It is also noteworthy that *K. galanga* gave an amino acid profile highest in Gly, Lys and Trp. Overall, they appeared similar to those of the leaves of legumes and other plants previously reported (Yeoh *et al.*, 1984, 1986). Chemical scores calculated based on WHO (1973) showed high values. Both *M. arvensis* and *P. sarmentosum* gave chemical scores of 80% with Ile as the limiting amino acid, while *K. galanga* and both *Asystasia* species gave chemical score values of 90% with Ile/Val as the limiting amino acids. Thus, the leaf amino acid compositions of these lesser utilised plants could be viewed as having a good complement of nutritionally essential amino acids.

It must be recognised that meaningful comparison of the data presented here with those previously reported for other plants may be difficult because of different procedures used in the analyses, and that agronomic practices and environmental conditions can also influence the cellular contents of the plants (Schmidt, 1971; Taylor *et al.*, 1983). Nonetheless, it is noteworthy that the values obtained for the different parameters for these plants appear to fall within the range reported for any of the commonly used leafy vegetables, and in some cases they are on the higher end of the scale (Lund *et al.*, 1983; Bawa & Yadav, 1986; Candlish *et al.*, 1987; Gupta & Wagle, 1988; Osman, 1990). Overall, the leaves of *A. gangetica*, *A. nemorum*, *M. arvensis* and *P. sarmentosum* might be regarded as protein-rich. Coupled with a good complement of nutritionally essential amino acids, favourable amounts of minerals and fibre, and the absence of anti-nutritional factors like trypsin and chymotrypsin inhibitors, and cyanide, these lesser utilised plants are indeed a potential food source worth promoting.

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Table 2. Total leaf amino acid composition of five lesser utilised tropical plants

Plant species	Amino acid composition (g% total amino acids)																
	Asp	Thr	Ser	Glu	Pro	Gly	Ala	Val	Met	Ile	Leu	Tyr	Phe	His	Lys	Trp	Arg
A. gangetica	12·3	5·2	5·0	14·3	6·3	5·8	6·4	4·6	1·9	3·6	9·2	5·2	5·8	2·1	6·5	0·7	5·0
A. nemorum	11·8	5·3	5·3	14·0	6·0	6·0	6·6	4·6	1·9	3·7	9·4	5·4	6·1	2·1	6·2	0·8	4·7
K. galanga	10·8	4·9	5·5	13·6	5·5	9·0	5·6	4·9	2·1	3·4	9·0	4·3	5·9	2·2	7·0	2·0	4·1
M. arvensis	12·6	5·1	4·8	15·5	6·0	5·4	6·5	4·9	2·0	3·4	9·1	4·6	6·1	2·2	6·3	1·0	4·4
P. sarmentosum	11·7	5·0	5·7	14·4	6·3	6·2	6·5	4·7	2·0	3·3	9·2	5·4	6·0	2·2	6·5	0·5	4·4

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