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Studies on Tropical Vegetables. Part 2: Amino and Fatty Acid Composition in Seed of Cleome (*Gynandropsis gynandra* L. Briq) Selections from Zambia

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ABSTRACT

*Seed of cleome (*Gynandropsis gynandra *L. Briq) contained 29·5% crude protein and 27·7% lipid. The highest values of crude protein (31·4%) and lipid (29·6%) were found in 'Purple Stem' while 'Green Stem' had the lowest values of 27·9% protein and 25·1% lipid. Oleic and linoleic acids accounted for 80·7% of the total fatty acids in which linoleic acid was most abundant (58·93%). The high degree of unsaturation is manifest in the high iodine and saponification numbers (123 and 192 respectively) of the oil. Cultigens exhibited slight variation in the proportions of fatty acids and had generally lower stearic (6·55%) than palmitic acid (11·2%). Arachidic and eicosenoic acids occurred in least proportions. Amino acid analysis of defatted meal revealed the abundance of glutamic acid, arginine and aspartic acid in which 'NIRS-2' and 'NIRS-3' had relatively higher values. Lysine, tyrosine and histidine were the lowest. The amino acid profile is comparable to that in leguminous oil seeds.*

INTRODUCTION

Cleome (*Cleome gynandra* L. *syn Gynandropsis gynandra* L. Briq) commonly known as 'cats whiskers' or 'spider-herb', a member of the family Capparidaceae, is a semi-cultivated pan-tropical green leafy vegetable (Watt & Breyer-Bradwijik, 1962; Terra, 1966; Jardin, 1970; Martin & Ruberte, 1979). Lewis (1972) and Vernon (1984) have described several species

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occurring in Zambia of which *G. gynandra* is the most widely used (Anon., 1984).

Seeds of several species of *Cleome* have been shown to be oleagenous and attempts to characterize their oil have been published. Thus, seed of *Cleome viscosa* (Ahmad *et al.*, 1978; Rukmini, 1978; Rao *et al.*, 1980); *C. icodandra* (Devi & Zaidi, 1977); *C. pentaphylla* (Misra & Dutt, 1977); *C. pungens*, *C. serulata*, and *C. spinosa* (Earle *et al.*, 1959, 1960); and *C. dolicostyla* (Ahmad *et al.*, 1984) have been analysed. Data is, however, lacking for oil characteristics of *C. gynandra* and amino acid profile of the seed in general. Further, the search for perhaps cheaper food, feed or industrial oils from indigenous plant species is of relevance to developing countries. This paper reports fatty and amino acids of the seed of several Zambian *Cleome gynandra* accessions.

MATERIALS AND METHODS

Seeds of four ecotypes, 'Purple Stem', 'Green Stem', 'NIRS-2' and 'NIRS-3' differing in stem colour, and vigour were collected from various parts of Zambia and multiplied on isolated plots at the National Irrigation Research Station (NIRS), Mazabuka.

Seed oil was extracted and both the fatty acids in the oil, and crude protein and amino acids in the defatted meal, were analysed by Svalof AB laboratories using methods detailed elsewhere (see Mnzava and Olsson, 1989).

RESULTS

Seeds were found to contain mean crude protein and lipid of 29·5% and 27·7% respectively. 'Purple stem' had highest protein (31·4%) and lipid

TABLE 1
Protein, Lipid Content and Oil Characteristics of Cleome (*Gynandropsis gynandra* L. Briq) Selections

Selections	*Crude protein (%)*	*Lipid (% dry matter)*	*Iodine number*	*Saponification number*
'Purple stem'	31·4	29·6	125	192
'NIRS-2'	30·0	29·1	120	192
'NIRS-3'	28·6	26·8	124	192
'Green stem'	27·9	25·1	123	192
Mean	29·5	27·7	123	192

TABLE 2
Fatty Acid Composition (% of total fatty acids) in Seed of Cleome (*Gynandropsis gynandra* L. Briq) Selection

Fatty acid	*Selections*				
	Purple stem	*NIRS-2*	*NIRS-3*	*Green stem*	*Mean*
Palmitic (16:0)	11·5	10·7	11·2	11·7	11·2
Palmitoleic (16:1)	0·3	0·4	0·3	0·3	0·3
Stearic (18:0)	6·40	7·60	6·10	6·10	6·55
Oleic (18:1)	19·6	23·9	21·5	22·2	21·8
Linoleic (18:3)	61·1	56·3	59·7	58·6	58·9
Arachidic (20:0)	0·10	0·20	0·20	0·20	0·18
Eicosenoic (20:1)	0·10	0·10	0·10	0·10	0·10

TABLE 3
Amino Acid Composition (g/100 g crude protein) of Zambian Selections of Cleome (*Gynandropsis gynandra* L. Briq) in Comparison to Leguminous Seed (Groundnut and Soyabean)

Amino acid	*Selections*						
	Purple stem	*NIRS-2*	*NIRS-3*	*Green stem*	*Mean*	*Groundnut*[a]	*Soyabean*[a]
Glutamic	16·4	17·9	18·6	16·8	12·9	12·6	15·7
Arginine	10·2	11·0	11·1	9·0	10·3	7·1	5·6
Aspartic	7·6	8·2	9·3	8·6	8·4	7·2	20·4
Leucine	5·6	6·1	6·3	5·5	4·4	4·2	6·2
Valine	5·4	5·7	5·9	5·5	5·8	2·9	4·1
Glycine	5·0	5·3	5·7	5·3	5·3	2·7	4·3
Proline	4·8	4·9	5·1	4·9	4·9	3·8	3·9
Phenylalanine	4·2	4·4	4·5	4·0	4·3	3·4	3·3
Isoleucine	4·0	4·3	4·4	3·9	4·2	3·5	3·7
Threonine	3·0	6·1	3·7	3·5	4·1	2·1	5·2
Alanine	3·8	3·9	4·1	3·8	3·9	1·1	3·8
Serine	3·4	3·6	4·1	3·9	3·8	1·2	3·9
Lysine	3·3	3·3	3·4	3·0	3·3	2·5	4·1
Tyrosine	2·4	2·5	2·4	2·3	2·4	1·4	2·1
Histidine	2·2	2·2	2·5	2·4	2·3	2·5	2·9

[a] Adapted from Jansen *et al.* (1979).

(29·6%), while 'Green stem' had the lowest (Table 1). However, iodine and saponification numbers (123 and 192 respectively) were similar.

Lipid analysis indicated that linoleic acid was the principal fatty acid, accounting for over 50% of total fatty acids in all cultigens. 'Purple stem' had the highest levels (61·1%) and 'NIRS-2' the lowest (56·3%) (Table 2). Oleic acid was the second major fatty acid. Cultigens with high linoleic acid had lower oleic acid and *vice versa*. Palmitic (11·2%) and palmitoleic acids (0·3%) were found in equal levels in all accessions and stearic acid averaged 6·55%. Levels of linoleic, arachidic and eicosenoic acids were relatively low in all cultigens.

Amino acid analyses (g/100 g-crude protein) revealed that glutamic (12·9), arginine (10·3) and aspartic acid (8·4) were the most abundant and that 'NIRS-2' and 'NIRS-3' had comparatively higher values (Table 3). Lysine (3·3), tyrosine (2·2) and histidine (2·3) were the lowest. Although variation existed between entries, 'Green Stem' had consistently lower values of each amino acid examined.

DISCUSSION

Analysis of cleome seed oil reflected a high degree of unsaturation comparable to that of other consumed oils reported by Swern (1979). Linoleic acid was found to be the dominant fatty acid followed by oleic acid, a trend similar to that reported for other species (Table 4). There is inherent variation between species and our data indicate marked differences within accessions. Although Terra (1966) indicated that *Cleome gynandra* L. is similar to *Gynandropsis gynandra* (Briq) and *C. pentaphylla* (A.DC.), comparison of fatty acid analyses in seed of *C. pentaphylla* reported by Misra and Dutt (1977), shows marked differences suggestive of genetic divergence between the species or, plausibly, reflecting differences due to environment. Data reported in this paper suggest that *G. gynandra* seed oil is comparable to that of *C. dolichostyla* analysed by Ahmad *et al.* (1984) and *C. viscosa* studies by Rukmini (1978) and Rao *et al.* (1980).

Seed protein is high and is comparable to that in oil seeds, e.g. groundnut (Platt, 1962). The amino acid profile is also in agreement with numerous data on seed analyses in which glutamic acid, arginine and aspartic acid are dominant (Jansen *et al.*, 1979). The variation in amino acid levels suggests possible inherent differences between accessions and that 'NIRS-2' and 'NIRS-3' are genetically similar while 'Purple Stem' and 'Green Stem' are different, as reflected in variation in plant form between these two. The relatively high oil and protein contents of *G. gynandra* seed make the plant of possible future use if toxicological studies suggested by Rukmini (1978)

TABLE 4

Mean Fatty Acid Comparison of Crude Oil in Seed of *C. gynandra* of Zambian Accession (g/100 g) in Comparison to Other Species of *Cleome*

Fatty acid	C. gynandra[f]	C. dolichostyla[a]	C. pungens[b]	C. serulata[c]	C. spinosa[c]	C. pentaphylla[d,f]	C. viscosa[e]
C16:0 Palmitic	11·2	10·4	*	—	—	9·60	17·20
C16:1 Palmitoleic	0·4	0·3	—	—	—	—	—
C18:0 Stearic	6·55	4·5	—	—	—	9·50	3·60
C18:1 Oleic	21·8	30·5	32·0	21·0	36·0	32·0	19·9
C18:2 Linoleic	58·9	52·2	41·0	38·0	40·0	39·0	67·3
C18:3 Linoleic	0·85	1·2	4·0	29·0	4·0	—	—
C20:0 Arachidic	0·18	0·5	—	—	—	—	—
C20:0 Eicosenoic	0·1	0·1	—	—	—	—	—

* Not reported.

[a] Ahmad *et al.* (1984).

[b] Earle *et al.* (1959).

[c] Earle *et al.* (1960).

[d] Misra and Dutt (1977).

[e] Rukmini (1978).

[f] Terra (1966) indicates *Cleome gynandra* L. as syn to *Gynandropsis gynandra* L. Briq. and *C. pentaphylla* (A.DC.).

are carried out. The low seed yield (0·2–0·5 tonnes ha^{-1}) among Zambian accessions (Mnzava, 1986) is due to intermittent sterility, indeterminate flowering, and consequent seed shattering and a pest complex, causing poor pod and seed set. The potential of *G. gynandra* as a dual purpose plant might be realised if genetic and cultural improvements are made.

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