Food Chemistry **14** (1984) 21–26

Chemical Characterization of *Cleome dolichostyla* Seed Oil

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(Received: 14 October, 1983)

ABSTRACT

Oil extracted from C. dolichostyla *seeds constituted 31·2% of the whole seed. Results of the physical and chemical analyses of the oil for iodine number, saponification number, Hehner value, Reichert–Meissl number and refractive index compared well with the characteristics of other commonly consumed vegetable oils. Thin-layer chromatography, in conjunction with gas–liquid chromatography, revealed a relatively high degree of unsaturation, 84·1%, with a linoleic acid content of 52·2 followed by oleic, 30·6%; palmitic, 10·1%; stearic, 4·49% and linolenic, 1·17%. Based on these data,* C. dolichostyla *seed oil might have potential as an edible oil for human and/or animal consumption. However, toxicity studies on the safety of this oil are still needed.*

INTRODUCTION

Cleome dolichostyla, a member of the Capparidaceae family, is an annual glandular hairy herb. The flowers are in 15–30 flowered lax racemes, yellow with lilac veins. The fruit is an 18–28 mm long capsule. The seeds are tiny, brownish spheres and are rich in oil. The plant grows wild in many tropical waste lands and is not yet cultivated. The *dolichostyla* species was described by Jafri (1973) from Pakistan and was known to be distributed in Iran, Afghanistan and West Pakistan. S. Chaudry (pers. comm., 1980) collected it for the first time from Saudi Arabia (a new

Food Chemistry 0308-8146/84/$03·00

record for the Arabian Peninsula). Reports are available in the literature on the oil content and characteristics of certain *Cleome* species such as *C. viscosa* (Ahmad *et al.*, 1978; Rukmini, 1978; Rao *et al.*, 1980), *C. icosandra* (Devi & Zaidi, 1977), *C. pentaphylla* (Misra & Dutt, 1937), *C. Pungens*, *C. serrulata* and *C. spinosa* (Earle *et al.*, 1959, 1960). However, data are still lacking on the oil of the *dolichostyla* species. The present study reports on certain physical and chemical characteristics of the oil of *C. dolichostyla* collected in Saudi Arabia and its fatty acid composition.

MATERIALS AND METHODS

Extraction of the oil

Seeds of *C. dolichostyla* were collected from the vicinity of Riyadh city, Saudi Arabia. The seeds were ground by a high speed shearing micromil and about 120 g of the ground seeds were extracted for 24 h with hexane in a Soxhlet extractor. After extraction, the solvent was removed by a rotary evaporator under reduced pressure and the oil flushed with nitrogen and stored under refrigeration for further analysis.

Chemical analysis of oil

Chemical analyses of the oil for iodine number, saponification number, acid value, Hehner value, Reichert-Meissl number and unsaponifiable matter were carried out according to the standard methods of the AOAC (1980). Refractive index was determined by an Abbe refractometer with temperature adjustment (American Optical, Model 10450).

Isolation and identification of fatty acids

The extracted oil was dissolved in chloroform and subjected to thin-layer chromatography for the separation of neutral lipids using silica gel G plates (0·5 mm) and a solvent system of petroleum ether: diethylether:acetic acid (74·5:25:0·5 ml). For the preparation of the fatty acid methyl esters, the oil was refluxed with 15 ml of a 14% solution of BF_3-MeOH and 5 ml benzene according to procedures outlined by the AOCS (1974). After extraction with diethyl ether, the extract was dried with anhydrous sodium sulfate and evaporated to

dryness under reduced pressure. Quantitative analyses of the methyl esters were performed with a gas–liquid chromatograph (HP 5370A) equipped with a hydrogen flame ionization detector using a 2 mm × 3 m glass column packed with 10% DEGS-PS on 100/120 mesh Supelcoport. Injections were made at 120–200 °C with a temperature increase of 4 °C/min with a 48 min hold. The carrier gas used was N_2 (40 ml/min) with a hydrogen and air flow rate of 40 ml/min and 200 ml/min, respectively. Identification of the different peaks was done by comparing their retention times with those of authentic standards and peak areas were integrated by a computing integrator. Fatty acid profile was quantitated according to procedures outlined by the AOCS (1977).

RESULTS AND DISCUSSION

Seeds of *C. dolichostyla* were found to contain 31·2% oil. The oil had a yellowish light brown color with a mild characteristic flavor and odor and a very slight bitter taste. Results of the physical and chemical analyses of oil (Table 1) showed a relatively high iodine value, thus reflecting a high degree of unsaturation, a high acid value, average values for saponification number, Hehner value, unsaponifiable matter, Reichert–Meissl number and refractive index compared with other consumed vegetable oils (Swern, 1979).

Thin-layer chromatography of the oil, in conjunction with gas–liquid chromatography of the fatty acid methyl esters, showed that the degree of unsaturation was about 85% (Table 2). Linoleic acid was found to be the dominant fatty acid, 52·2%, followed by oleic, 30·6%; palmitic, 10·1%;

TABLE 1
Physical and Chemical Characteristics of *C. dolichostyla* Seed Oil

Assays	*Value*
Refractive index	1·470 5
Iodine number (WIJIS)	119
Saponification number	194
Acid value, as per cent oleic	29·7
Hehner value	48·1
Reichert–Meissl number	1·76
Unsaponifiable matter (%)	2·43

TABLE 2
Fatty Acid Composition of Crude Oil of *C. dolichostyla* Seed Oil (g/100 g)

Fatty acid	C. dolichostyla	C. pungens[a]	C. serrulata[b]	C. spinosa[c]	C. pentaphylla[d]	C. viscosa[e]
$C_{14:0}$	0·1	—*	—	—	—	—
$C_{15:0}$	<0·1	—	—	—	—	—
$C_{16:0}$	10·1	—	—	—	9·6	17·2
$C_{16:1}$	0·3	—	—	—	—	—
$C_{17:0}$	0·1	—	—	—	—	—
$C_{18:0}$	4·5	—	—	—	9·5	3·6
$C_{18:1}$	30·5	32·0	21·0	36·0	32·0	11·9
$C_{18:2}$	52·2	41·0	38·0	40·0	39·0	67·3
$C_{20:0}$	0·5	—	—	—	—	—
$C_{18:3}$	1·2	4·0	29·0	4·0	—	—
$C_{20:2}$	0·1	—	—	—	—	—
$C_{22:0}$	<0·1	—	—	—	—	—
$C_{20:4}$	<0·1	—	—	—	—	—
$C_{23:0}$	<0·1	—	—	—	—	—
Saturates	—	19·0	8·0	16·0	—	—

* Not reported.
[a] Earle *et al.* (1959).
[b] Earle *et al.* (1960).
[c] Earle *et al.* (1960).
[d] Misra & Dutt (1937).
[e] Rukmini (1978).

stearic, 4·49% and linolenic acid, 1·17%. Fatty acids of chain lengths greater than C_{18} were only found in insignificant amounts under these conditions. Rukmini (1978) and Rao *et al.* (1980) reported that the percentages of oleic acid in *C. viscosa* oil were 11·90% and 14·40% and those of linoleic, 67·27% and 68·60%, respectively. These values are significantly different from those of *C. dolichostyla* even though the degrees of unsaturation of both oils are in close agreement. Moreover, the contents of the major unsaturated fatty acids in *C. dolichostyla* oil were different from those of other Cleome oils such as *C. pungens*, $C_{18:1} = 32\%$; $C_{18:2} = 41\%$; $C_{18:3} = 4{\cdot}0\%$ (Earle *et al.*, 1959), *C. serrulata*, $C_{18:1} = 21\%$; $C_{18:2} = 38\%$; $C_{18:3} = 29\%$ and *C. spinosa*, $C_{18:1} = 36\%$; $C_{18:2} = 40\%$; $C_{18:3} = 4\%$ (Earle *et al.*, 1960) and *C. pentaphylla*, $C_{18:1} = 32\%$; $C_{18:2} = 39\%$ (Misra & Dutt, 1937) and *C. viscosa*, $C_{16:0} = 17{\cdot}2\%$; $C_{18:0} = 3{\cdot}6\%$; $C_{18:1} = 11{\cdot}9\%$; $C_{18:2} = 67{\cdot}3\%$ (Rukmini, 1978). On the other hand, the high degree of unsaturation of the *C. dolichostyla* oil is comparable with those of other commonly consumed vegetable oils such as corn, sunflower, olive and sesame, but

less than that of safflower (Swern, 1979). However, the amount of linolenic acid is close to that of safflower which might have an adverse effect on the stability of the oil.

From data obtained it appears that oil of *C. dolichostyla* might be of use as a source of edible oil for human and/or animal consumption. However, further studies are still needed on the toxicity and edibility of the oil to confirm its safety in food and/or feed. The fact that *C. dolichostyla* is a drought-tolerant crop which is adapted to arid and semi-arid lands, might add to its importance as a potential oil-seed crop for many desert areas of the world where the lack of water constitutes the major constraint to agricultural production. However, the economic feasibility with respect to yield, propagation and the breeding of high yielding varieties that are suitable for cultivation also needs to be investigated.

ACKNOWLEDGEMENTS

The authors thank Dr S. Abu-Shakra for his critical review of the manuscript. Skilful technical assistance by Messrs M. Al-Mahammad and P. Khan is highly appreciated.

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