Fatty Acid Composition of Oils of Some Edible Seeds of Wild Plants

Carola Engelter and A. S. Wehmeyer

The fatty acid composition of the oil obtained from the edible seeds of some wild fruits and plants was determined by gas–liquid chromatography. The five samples investigated were *Sclerocarya caffra*, *Bauhinia esculenta*, *Ricinodendron rautanenii*, *Trichilia emetica*, and *Adansonia digitata*. Although the fatty acid contents of the five oils differ widely, the oils of *Bauhinia esculenta*, *Ricinodendron rautanenii*, and *Adansonia digitata* are good sources of linoleic acid. The oil of *Sclerocarya caffra* contains 70% oleic acid, while the oil of *Trichilia emetica* is the only one containing a small percentage of linolenic acid (1% of the total acids). A significant amount of two unidentified fatty acids is present in the oil of *Ricinodendron rautanenii*.

In certain regions of southern Africa, edible wild fruits and plants, and the seeds of some of these, play an important role in the diet of certain Bushmen and Bantu tribes.

The systematic survey of the nutrient composition of these foodstuffs was commenced recently by the National Nutrition Research Institute. The results obtained on the nutrient content of a few varieties of wild fruits were published by Wehmeyer (1966). Very little is known about the fatty acid composition of the oils of edible seeds of wild plants in South Africa. The only figures available are those of Ligthelm *et al.* (1952) who studied the composition of the oil of *Sclerocarya caffra* by classical chemical methods. Hence we have determined the fatty acids in the oil of four different species of seeds borne by trees, viz. *Sclerocarya caffra*, *Ricinodendron rautanenii*, *Trichilia emetica*, and *Adansonia digitata* and one (*Bauhinia esculenta*) a legumelike seed.

MATERIALS AND METHODS

One sample of oil obtained from the seeds of each plant species growing in a particular area was analyzed. Immediately prior to extraction of the oil, 2 to 4 grams of the kernels were finely ground in a mortar. The ground material was transferred to a glass-stoppered Erlenmeyer flask, a 20-fold volume of chloroform : methanol (2 to 1) mixture added, the flask shaken for approximately 2 hours, and then left overnight in the dark. The contents of the flask was filtered and the residue on the filter paper re-extracted in a Soxhlet apparatus at approximately 50° C. for 2 hours, a small quantity of hydroquinone being added to inhibit oxidation of the oil.

The lipid solutions were washed free from nonlipid materials by the method of Folch *et al.* (1957) and then dried with anhydrous sodium sulfate. Aliquots which corresponded to about 100 mg. of oil were taken, the solvent was evaporated, and the oil saponified with alcoholic potassium hydroxide (5%) for 40 minutes at 60° C. The unsaponified material was removed by extraction with low boiling petroleum ether and after acidifying the saponified mixture, the free fatty acids were extracted with low boiling petroleum ether. The methyl esters were then prepared according to the method of Rogozinski (1964), which uses methanol and an excess of concentrated sulfuric acid, and finally dissolved in 2 ml. of *n*-hexane (Fisher Scientific Co., certified reagent). Because of its convenience and speed, we consider this method to be superior to that of Metcalfe and Schmitz (1961).

National Nutrition Research Institute, Council for Scientific and Industrial Research, P.O. Box 395, Pretoria, South Africa

GAS-LIQUID CHROMATOGRAPHY

The conditions used for the separation of the methyl esters ranging from 14 to 24 carbon atoms were as follows:

Instrument:	Perkin-Elmer Model 800.
Columns and stationary phase:	8-foot stainless steel, 1/8-inch O.D. packed with 20% (w./w.) PEGS ester on chromosorb W, 60- to 80-mesh (Perkin-Elmer Corp.). The columns were conditioned at 180° C overnight.
Temperature:	Oven 190° C. Injector port 250° C. Detector 170°C. (180° C. in the case of *Trichilia emetica* and *Adansonia digitata*)
Carrier gas:	Nitrogen, inlet pressure 17 p.s.i., regulated to a flow speed of 34 ml./minute at the detector.
Detector:	Flame ionization, hydrogen pressure 17 p.s.i. and oxygen pressure 35 p.s.i. (15 and 35, respectively, in the case of *Trichilia emetica* and *Adansonia digitata*).
Recorder:	Leeds and Northrup Speedomax W
Chart speed:	0.5 inch per minute.
Integrator:	Perkin-Elmer Model D2 with Kienzle printer—used for *Trichilia emetica* and *Adansonia digitata* only.

The fatty acid methyl ester peaks were identified by comparing the retentions obtained with those of a synthetic mixture of standard fatty acid methyl esters when chromatographed under identical conditions. In some cases a small amount of an authentic substance was added to the sample,

Table I. Mean Fatty Acid Composition of Five Seed Oils (Expressed as Percentages of the Total Fatty Acids)—Together with the Standard Deviations

Fatty acid	*Sclerocarya caffra*	*Bauhinia esculenta*	*Ricinodendron rautanenii*	*Trichilia emetica*	*Adansonia digitata*
14:0	Trace	Trace	Trace	...	Trace
16:0	12.0 ± 0.6	14.1 ± 0.3	9.5 ± 0.3	38.3 ± 0.6	26.5 ± 0.9
16:1	Trace	0.7 ± 0.1	Trace		0.4 ± 0.1
16:2	Trace	Trace	Trace	...	Trace
18:0	9.2 ± 0.3	6.5 ± 0.3	7.6 ± 0.2	2.2 ± 0.2	4.4 ± 0.3
18:1	69.9 ± 0.9	47.9 ± 0.9	17.7 ± 1.0	48.5 ± 0.9	32.3 ± 0.2
18:2	7.8 ± 0.4	24.6 ± 0.4	42.9 ± 1.2	10.4 ± 0.6	34.9 ± 0.5
18:3	...	...	...	1.0 ± 0.3	...
20:0	0.6 ± 0.1	3.3 ± 0.4	Trace	...	1.9 ± 0.1
20:1	0.3 ± 0.1	1.0 ± 0.2	0.6 ± 0.2	...	
22:1	...	1.8 ± 0.2	...	...	Trace
Unidentified components	...	...	21.7 ± 1.1	...	...
Number of determinations	8	6	5	7	3

The results were also confirmed by applying the graphic identification ("log-plot") method. The graphs obtained for both the saturated as well as the mono-unsaturated fatty acid series, show the expected linear relation between log retention and chain length. For minor components the carbon number identification method of Woodford and van Gent (1960) proved to be extremely useful.

The fatty acid percentages were calculated from the peak areas obtained by using the peak height × band width (= width at half height) method for long sharp peaks and by planimetry for small broad peaks. In the cases of *Trichilia emetica* and *Adansonia digitata*, an electronic integrator calculated the peak areas.

RESULTS AND DISCUSSION

The results are given in Table I.

The kernel of *Sclerocarya caffra* is encased in a very hard and thick shell but even though quite small, it is regarded as a delicacy on account of its delicious taste. Considering the limitations of the old techniques, the results obtained by Ligthelm *et al.* (1952) agree fairly well with ours, especially if total saturated as well as total unsaturated fatty acids are compared.

The kernel of *Ricinodendron rautanenii* is larger than that of *Sclerocarya caffra*, but is encased in an even harder and thicker shell. The stones are often but not necessarily roasted before the kernels are extracted, the latter having a hazelnut-like taste. The oil is interesting as it contains two fatty acids, probably isomers, which we could neither identify nor separate under the conditions employed.

The *Bauhinia esculenta* seeds are borne in pods. The seeds are always roasted before being eaten, and have a coffee-like taste. The raw kernel is rather tasteless and has a slimy texture when chewed.

The embryos of the seeds of *Adansonia digitata* are eaten raw or roasted and have a pleasant nutty flavor.

The seeds of *Trichilia emetica* are soft and the oil is easily expressed. The seeds are not eaten as such but the oil is expressed and used as a cooking oil. It is also the only one of the five oils investigated containing some linolenic acid (1%).

ACKNOWLEDGMENT

The authors thank the Council for Scientific and Industrial Research for permission to publish this paper and A. le R. van der Merwe for obtaining a sample of *Trichilia emetica* seeds

LITERATURE CITED

Folch, J., Lees, M., Sloane-Stanley, G. H., *J. Biol. Chem.*, **226,** 497(1957).
Ligthelm, S. P., Schwartz, H. M., von Holdt, M. M., *J. S. African Chem. Inst.* **4** (2), 1 (1952).
Metcalfe, L. D., Schmitz, A. A., *Anal. Chem.* **33,** 363 (1961).
Rogozinski, M., *J. Gas Chromatog.* **2,** 328 (1964).
Wehmeyer, A. S., *S. African Med. J.* **40,** 1102 (1966).
Woodford, F. P., van Gent, C. M., *J. Lipid Research* **1,** 188 (1960).

Received for review July 1, 1969. Accepted September 15, 1969.