Oil of Chapote Amarillo (*Sargentia greggi*): 2,5-Dimethoxyflavone in the Unsaponified Fraction

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The fatty acid analysis of the hexane extract of fruits and seeds of chapote amarillo (*Sargentia greggi* S. Wats.) was carried out. Palmitic, linoleic, and erucic acid constitute up to 60% of the fatty acids. 2,5-Dimethoxyflavone was found in the unsaponified fraction.

Keywords: *Sargentia gregii; Rutaceae; chapote amarillo; oil analysis; erucic acid; 2,5-dimethoxyflavone*

INTRODUCTION

Sargentia greggi S. Wats, from the Rutacea family (Plummer, 1941), has been classified as a citrus which is native to the humid areas of Tamaulipas, Nuevo Leon, and San Luis Potosí in Mexico (Puig, 1976). It is the main wild host of the Mexican fruit fly (*Anastrepha ludens* Loew) (Baker et al.,1944; González and Tejada, 1979). The fly's larvae grow inside the seed (Plummer, 1941; Puig, 1976; Baker et al., 1944; González and Tejada, 1979; Darby and Kapp, 1934; Pérez, 1987), which has a fresh weight around 60% of the edible fruit. This study was undertaken to determine the composition of the hexanic extract of pulp and seed of chapote amarillo to determine whether there are some compounds that are attractive to the Mexican fruit fly and to find possible uses for the oil. Volatile compounds of the fruit have been previously reported (Sánchez-García Figueroa et al., 1991).

MATERIALS AND METHODS

Standards. Altech FAME 18813 mixture of fatty acid esters was used for calibration of the GLC column.

Hexanic extracts were obtained from 45 g of dried ground seeds and from 51g of *S. greggi* pulp in a Soxhlet apparatus.

Fatty Acids. One gram of evaporated extract was saponified with alcoholic 5 N KOH. Fatty acids were esterified with diazomethane (Fieser, 1967). Gas chromatography of esters (1 μL) was carried out using a $^1/_8 \times 6$ ft, 20% ethyleneglycol sebacate (EGS) column. The column was temperature programmed from 150 to 200 °C at 4 °C/min (Soler et al., 1988). Identification of the fatty acid esters was made according to the AOAC procedure (Keneth, 1990).

Unsaponified Fraction. A crystalline solid was separated from the concentrated hexane solution of unsaponified material, which was isolated by filtration and purified by recrystallization from acetone–hexane. It showed a melting point of 190 °C. Its structure was spectroscopically determined with the following instruments: a Shimadzu 2100 UV spectrophotometer, a Perkin-Elmer 599B IR spectrometer, a Varian EM 390, 60 MHz NMR spectrometer, and a Hewlett-Packard 59854-A mass spectrometer.

RESULTS AND DISCUSSION

Amounts of 1.9 g of hexane extractives were obtained from the pulp and 1.7 g from the ground seeds of *S. greggi*. These amounts represent only 3.8% of the seed, a low yield compared with the extract of other citrus seeds (13–20%). The yield of extractives in pulp and skin (3.7%) is high compared with that of other citrus fruits (0–0.4%) (Broson, 1980).

Table 1. Percentage Composition of the Methyl Esters of Fatty Acids in Seeds and Pulp from Chapote Amarillo Fruit

methyl ester from the acid	% pulp and peel	% in seeds
caproic	0.443	1.353
$C_{6:1}$[a]	0.200	8.346
caprilic	0.040	0.037
$C_{8:1}$[a]	0.848	0.230
capric	1.331	6.013
$C_{10:1}$[a]	0.051	1.326
lauric	1.309	4.280
lauroleic	1.274	0.537
C_{13}	1.354	0.567
laurolenic	1.413	0.787
myristic	1.760	3.523
myristoleic	1.630	0.037
C_{15}	0.082	0.288
palmitic	27.177	28.445
palmitoleic	4.927	6.809
estearic	3.888	2.694
oleic	9.907	26.531
linoleic	15.142	7.695
araquic		0.740
linolenic		8.115
erucic	18.169	

[a] Monounsaturated acids according to Keneth (1990).

The pulp extract consists of 35% fatty acids and 65% unsaponified material. The last figure is larger than in most oils, which contain between 0.3 and 2% (Broson, 1980). Fatty acids make up 50% of the seed oil. Seed fatty acids contain 45.3% saturated fatty acids and 54.7% nonsaturated fatty acids, whereas pulp has 48% saturated and 52% nonsaturated fatty acids.

Investigation of the fatty acids in the extract was carried out by gas chromatography of the methyl esters. These data are shown in Table 1, which shows that palmitic, linoleic, and erucic are the three most important fatty acids in the seeds of *S. greggi*. Although palmitic and linoleic acids are common in the Rutacea family, erucic acid, which is found in Cruciferacea, is uncommon in this family (Hilditch, 1956). The presence of erucic acid in the hexanic extract of this fruit is of concern, since this fruit is edible and there are several reports on the toxicity of erucic acid: Duthie et al. (1988), Rose et al. (1981), Abdellatif and Vles (1973), Astorg and Levillain (1977), and others have reported morphological changes in the myocardium, and Bhatnagar and Yamashiro (1974) reported ultrastructural

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studies that showed alterations in the intravascular lipid globules and in the mitochondria. Yamashiro et al. (1975), on the other hand, reported liver lesions in hens.

A crystalline solid separated from the unsaponified material, which was isolated by filtration and purified by recrystallization from acetone–hexane. This solid is a homogeneous compound with a melting point of 190 °C. Its infrared spectra showed bands at 3080, 2920, 1650, 1590, 1490, and 1080 cm^{-1}, which indicated a conjugated C=O functionality, aromatic protons, and C–O vibrations. The UV spectrum has two bands at 280 and 310 nm. A flavone was suggested from these data (Markham and Mabry, 1975). Although the presence of flavones in the hexane extract of these seeds has not been reported, four flavones have been reported as constituents of the ethanolic extracts of roots and fruits of *S. greggi* (Meyer et al., 1985).

The mass spectrum showed *m/e*, 282 (M+), 267 (100%) ($M^+ - CH_3$), 239 ($M^+ - CH_3 - CO$) fragments. Proton magnetic resonance chemical shifts occurred at 7.9 (2H), 7.5 (3H, m), 7.3 [2H, m, (H-7,8)], 6.68 (1H, s), 3.9, and 3.85 (6H, s) ppm.

Methoxyl group signals are shifted to 14.65 (MeO 5) and 3.7 (MeO 6) using $Eu(fod)_3$. Ring protons are also shifted as follows: H-7, 1.7, $J = 9$; H-8, 2.5, $J = 9$; all other protons did not shift (Okigawa et al., 1975).

^{13}C NMR showed 17 carbon atoms: 8 as singlets and 2 methoxyl groups. Chemical shifts were as follows: 177.973, 161.49, 151.45, 149.88, 147.79, 131.548, 131.311, 128.893, 126.04, 119.165, 118.921, 113.397, 107.889, 61.845, and 57.084 ppm.

Calculation of the chemical shift values for all ^{13}C NMR signals according to the method of Wilson et al. (1968), based on the ^{13}C NMR of 5-dimethoxyflavone, agreed with the values found for 5,6-dimethoxyflavone. All other spectral data also agree with the structure of 5,6-dimethoxyflavone for our unknown flavone.

5-Methoxyflavones have been reported as inhibitors of navel orange worm (Mahoney et al., 1989). 5,6-Dimethoxyflavone has been reported as an anticancer substance (Okigawa et al., 1975). The role of 5,6-dimethoxyflavone in the oil of *S. greggi* is under investigation.

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