Characterization and Quantitation of Hexadecyl, Octadecyl, and Eicosyl Esters of *p*-Coumaric Acid in the Vine and Root Latex of Sweetpotato [*Ipomoea batatas* (L.) Lam.]

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Methanol extracts of vine latex of four cultivars of sweetpotato [*Ipomoea batatas* (L.) Lam.] were analyzed for their chemical phenolic composition by reversed-phase HPLC. Major components were identified as hexadecyl, octadecyl, and eicosyl *p*-coumarates by an evaluation of data from UV spectra, hydrolysis, synthesis, and GC/MS of their trimethylsilyl derivatives. Both *Z*- and *E*-isomers of the phenolic acid were found, with the latter predominating. Trace quantities of hexadecyl (*Z*)- and (*E*)-ferulates were also identified in ester concentrates. Levels of octadecyl (*E*)-*p*-coumarate ranged from 0.7% fresh weight in cv. Resisto to almost 2% in cv. Jewel, while the hexadecyl ester levels were only $^1/_4$ to $^1/_3$ these values. Levels of the Z-esters were $^1/_{10}$ to $^1/_{20}$ of the levels of the corresponding *E*-isomers. Levels of the esters in cv. Jewel sweetpotato root latex were 2–10-fold the levels in the vine latex, while the ratio of *E*-esters to *Z*-esters was found to be 7–14-fold. The concentration of *Z*-esters among the sweetpotato cultivars tested correlated closely with the leaf feeding index for the sweetpotato weevil (*Cylas formicarius*) (R^2: C_{20} = 0.96; C_{18} = 0.98; C_{16} = 0.71). The results indicate a possible relationship between latex chemistry and insect resistance that might be exploited via plant breeding.

Keywords: *Sweetpotato; Ipomoea batatas (L.) Lam.; latex; phenolic acid fatty alcohol esters; sweetpotato weevil; Cylas formicarius*

INTRODUCTION

A wide range of plant species exude latex in response to surface wounding, the most common example being the rubber plant, *Hevea brasiliensis* Muell. (Roberts, 1988). Of the latex-producing species identified thus far (approximately 1800), the families Apocynaceae, Asclepiadaceae, Asteraceae, Euphorbiaceae, and Moraceae predominate (Bonner and Galston, 1947). Considerable evidence points toward a defensive role for latex against herbivores.

Latex is commonly found in specialized cells (laticifers) within the plant. The positive turgor pressure exhibited by the cells provides the driving force for the rapid release of latex upon puncture or cutting. As early as the beginning of this century, an antiherbivore role for latex was demonstrated by Kniep (1905). When leaves of a normally unacceptable Euphorbiacae were drained of latex, they became an acceptable food source for young slugs. More recent evidence describes an insect species that has developed a behavioral modification to circumvent the latex defense system, further substantiating the antiherbivore role of latex (Dussourd and Eisner, 1987). *Labidomera clivicollis* cuts the veins at the base of milkweed leaves (*Asclepias syriaca* L.), resulting in the loss of turgor pressure distal to the cut, thus rendering this tissue relatively latex free. The insect subsequently feeds on this portion of the leaf.

Sweetpotatoes, currently the seventh most important food crop in the world, are also a latex-secreting species and have relatively few serious insect pests. However, one insect species that does pose a significant problem for sweetpotato production in many areas of the world is the sweetpotato weevil (*Cylas formicarius*). While all parts of the plant (vines, leaves, and storage roots) are attacked by the sweetpotato weevil (Reinhard, 1923; Cockerham et al., 1954), the young apical tips of the vines are commonly avoided (N. S. Talekar, 1991, personal communication). The area of greatest latex production by the vines was found to be the young apical tissue, and weevil feeding increased with increased distance from the growing tip (Data and Kays, 1994). In addition, cultivars with increased latex production are thought by indigenous farmers in the Philippines to have a lower incidence of weevil damage (E. S. Data, 1992, personal communication). Collectively these facts suggest a possible antiherbirvore role for latex in the sweetpotato.

Insect resistance conferred by latex may be via chemical and/or physical means, the latter due largely to the very sticky nature of the material. The chemical composition of latex varies widely among species. Common components include polyisoprenes, proteins, amino acids, fatty acids, tetracyclic triterpenoids, glycerides, waxes, starch, flavonoids, organic and inorganic salts, alkaloids, and water (Gazeley et al., 1988; Kinghorn and Evans, 1975; Nielson et al., 1977; Webster, 1967). To date, little is known about the composition of the latex produced by the sweetpotato (Kays, 1992). As an initial step in ascertaining the potential antiherbivore role of

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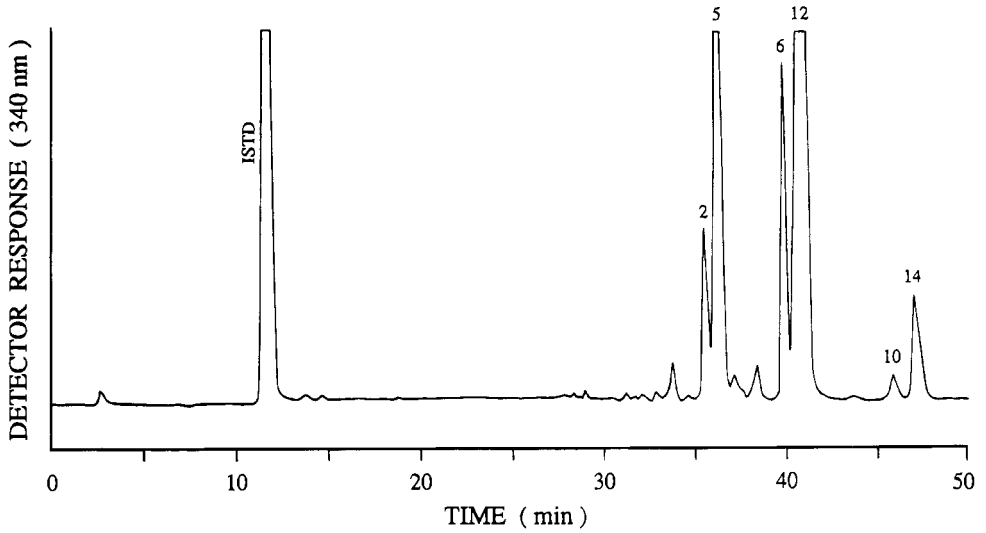


Figure 1. Typical HPLC chromatogram of potato vine latex phenolic acid esters. See Table 1 for peak identifications.

sweetpotato latex, we have characterized the primary components, laying the groundwork for future bioassays with a range of insect species.

MATERIALS AND METHODS

Plant Material. Plants were grown in 1992 at the University of Georgia, Horticulture Farm, Watkinsville, GA, using standard commercial cultural practices (Barber et al., 1986). Four cultivars, which we had analyzed previously for other phytochemical properties, were selected for analysis: Centennial, Jewel, Resisto, and Regal (Nottingham et al., 1988; Son et al., 1990; Wilson et al., 1990, 1991). The first two cultivars represent industry standards, while the second two are relatively new cultivars that have been selected for increased levels of resistance to the wireworm–*Diabrotica*–*Systena* complex comprised of the southern potato wireworm (*Conoderus falli*), tobacco wireworm (*Conoderus vespertinus*), banded cucumber beetle (*Diabrotica balteata*), spotted cucumber beetle (*Diabrotica undecimpunctata howardi*), elongate flea beetle (*Systena elongata*), pale-striped flea beetle (*Systema blanda*), *Systema frontalis*, sweetpotato flea beetle (*Chaetocnema confinis*), and white grubs (*Plectris aliena* and *Phyllophaga ephilida*) (Jones et al., 1983, 1985). Cv. Resisto and Regal display moderate levels of resistance to the sweetpotato weevil (*C. formicarius*), with the resistance due largely to the absence of the oviposition stimulant (boehmeryl acetate) found on the surface of the storage roots (Son et al., 1990; Wilson et al., 1990, 1991). The relative acceptabilities of the leaves of the four cultivars for feeding by the sweetpotato weevil (feeding index) were published previously (Nottingham, 1988).

Latex Sampling. Vines of approximately 70-day-old plants were severed at the second internode from the apex and several drops of latex collected into tared, 2-dram vials. Methanol (2.00 mL) was immediately added and the latex dissolved. Fresh weights of latex were then determined from gross weights. Solutions were frozen until analysis. Roots were sampled by carefully removing the soil from the main root system and then severing the root stalk leading into the storage roots. Latex was collected in the same manner as with the stems.

HPLC Analyses. Sweetpotato latex methanolic solutions were analyzed on a Beckman Ultrasphere C_{18} reversed-phase column: linear solvent gradient from 50% MeOH/H_2O to 100% MeOH in 20 min (0.1% H_3PO_4 in solvents pH 2.5). Column effluent was monitored at 340 nm. Quantitation was done by the internal standard method using 5,7-dimethoxycoumarin. Spectral acquisition of eluting peaks was accomplished with a Hewlett-Packard Model 1040 diode array monitor.

GC Analyses. Gas chromatographic analyses were performed with an immobilized SE-54 (30 m × 0.3 mm i.d.) capillary column prepared according to the method of Arrendale et al. (1988): injector, 250 °C; detector, 350 °C; temperature program, 100–300 °C at 8 °C/min. Analyses of synthetic and isolated phenolic acid esters were performed on trimethylsilylated derivatives (TMS) prepared from BSTFA/DMF (1:1) with heating (75 °C for 30 min).

Isolation of Phenolic Acid Esters. Approximately 6 g (fresh weight) of sweetpotato latex, collected from cv. Centennial, Jewel, Regal, and Resisto vines, was evaporated to dryness under a stream of nitrogen and dissolved in 10 mL of MeOH. The solution was submitted to preparative reversed-phase column chromatography. The packing material from a Waters Prep-Pak 500 C_{18} cartridge (Millipore Corp., Milford, MA) was repacked into a smaller glass Cheminert LC column (109 × 1.25 cm, Valco Instruments Co., Inc., Houston, TX), washed with MeOH, and recycled to 50% MeOH/H_2O. The solvent gradient employed was from 50%MeOH/H_2O to 100% MeOH in 200 min: flow rate, 2 mL/min; 8-mL fractions collected; effluent monitored at 340 nm. The esters eluted in three peaks over 15 fractions. After GC analyses, fractions containing similar components were combined to give a fraction with enriched levels of C_{16} *p*-coumarate (designated fraction A), C_{18} *p*-coumarate (fraction B), C_{20} *p*-coumarate (fraction C), and a mixture (fraction D). Hydrolysates from peak 5 (Figure 1) material yielded only hexadecyl alcohol and (*E*)-*p*-coumaric acid.

Synthesis of Phenolic Acid Esters. All solvents were analyzed reagent grade. *O*-(*E*)-Acetyl-*o*-, *m*-, and *p*-coumaric acid and *O*-acetyl-(*E*)-ferulic acid were prepared from the acid and acetic anhydride. The C_{16} and C_{18} esters of these acids were prepared by a modification of the method of Gunatilake and Sultanbawa (1973). Treatment of the acetylated acids (1 g of each) with thionyl chloride yielded the corresponding acid chloride. The acid chlorides were dissolved in $CHCl_3$ (5 mL) in a 20-mL scintillation vial, and 1 g of either C_{16}-OH or C_{18}-OH (in 5 mL of $CHCl_3$) was added. Several drops of pyridine were added to the vials, and the $CHCl_3$ was boiled off with the aid of a heating block. The resulting mixture was then heated at 100 °C in the heating block for 24–48 h. The mixture was then dissolved in $CHCl_3$ (50 mL) and 3 drops of putrescine (1,4-diaminobutane) added to hydrolyze the acetate groups. The solution was then washed with 0.1 N HCl (2 × 50 mL) and then H_2O (2 × 50 mL). After evaporation of the chloroform, the solid residue was dissolved in hexane and chromatographed on silicic acid (SA 20 g, Mallinkrodt, 100 mesh, washed with MeOH and activated at 155 °C for 16 h). For the *p*-coumaric and ferulic esters, the column was eluted with 100 mL each of hexane, followed by 10% CH_2Cl_2/hexane, 50% CH_2Cl_2/hexane, 100% CH_2Cl_2, and 20% EtOAc/CH_2Cl_2. The *p*-coumaric esters were found in the 20% EtOAc/CH_2Cl_2 fraction, while the ferulic esters were found in the 100% CH_2Cl_2 and 20% EtOAc/CH_2Cl_2 fractions. Both ferulic ester

fractions were combined and rechromatographed on SA with 40% CH_2Cl_2/hexane. The *o*-coumaric ester reaction mixtures were chromatographed on SA with 50% CH_2Cl_2. Isolated esters were recrystallized from either hexane or $CHCl_3$.

Properties of synthesized esters are given below (postulated MS fragmentation ions given for C_{16} *o*-, *m*-, and *p*-coumarate and ferulate only; MS probe for neat samples, GC/MS for TMS derivatives).

Hexadecyl (E)-o-Coumarate (*C_{16} o-Coumarate*): mp 57.5–58 °C; EI-MS *m/z* 388 $[M]^+$ (3), 146 [coumarin]$^+$ (100); EI-GC/MS (TMS) *m/z* 460 $[M]^+$ (14), 445 $[M - CH_3]^+$ (8), 277 (7), 236 $[M - C_{16}H_{32}]^+$ (26), 221 $[M - CH_3 - C_{16}H_{32}]^+$ (100) (see discussion in text), 219 [acylium]$^+$ (40), 192 $[219 - CO + H]^+$ (10), 179 $[M - C_{18}H_{33}O_2]^+$ (10), 146 [coumarin]$^+$ (41).

Octadecyl (E)-o-Coumarate (*C_{18} o-Coumarate*): mp 77–77.5 °C; EI-MS *m/z* 416 $[M]^+$ (10), 146 (100); EI-GC/MS (TMS) *m/z* 488 $[M]^+$ (7), 473 (5), 277 (6), 221 (100), 219 (40), 192 (10), 179 (11), 146 (35).

Hexadecyl (E)-m-Coumarate (*C_{16} m-Coumarate*): mp 75–76.5 °C; EI-MS *m/z* 388 $[M]^+$ (4), 281 (10), 164 $[M - C_{16}H_{32}]^+$ (100), 147 [acylium]$^+$ (66); EI-GC/MS (TMS) *m/z* 460 $[M]^+$ (21), 281 (16), 238 (32), 236 $[M - C_{16}H_{32}]^+$ (100), 221 $[M - CH_3 - C_{16}H_{32}]^+$ (54), 219 [acylium]$^+$ (51), 203 (38), 192 $[219 - CO + H]^+$ (8).

Octadecyl (E)-m-Coumarate (*C_{18} m-Coumarate*): mp 81.5–82.5 °C; EI-MS *m/z* 416 $[M]^+$ (4), 309 (10), 164 (100), 147 (74); EI-GC/MS (TMS) *m/z* 488 $[M]^+$ (20), 473 (1), 238 (38), 236 (100), 221 (63), 219 (63), 203 (40), 192 (8).

Hexadecyl (E)-p-Coumarate (*C_{16} p-Coumarate*): mp 84–86 °C; EI-MS *m/z* 388 $[M]^+$ (8), 166 $[M - C_{16}H_{30}]^+$ (40), 164 $[M - C_{16}H_{32}]^+$ (100), 147 [acylium]$^+$ (53), 120 $[147 - CO + H]^+$ (18), 107 $[HOPhCH_2]^+$ (16); EI-GC/MS (TMS) *m/z* 460 $[M]^+$ (38), 445 $[M - CH_3]^+$ (2), 238 (61), 236 $[M - C_{16}H_{32}]^+$ (100), 221 $[M - CH_3 - C_{16}H_{32}]^+$ (31), 219 [acylium]$^+$ (60), 192 $[219 - CO + H]^+$ (43), 179 $[M - C_{18}H_{33}0_2]^+$ (72).

Octadecyl (E)-p-Coumarate (C_{18} *p-Coumarate*): mp 86–87 °C, recrystallized from $CHCl_3$ [Lit. 99–100 °C from $CHCl_3$ (Gunatilake and Sultanbawa, 1973)]; EI-MS *m/z* 416 $[M]^+$ (10), 166 (50), 164 (100), 147 (57), 120 (20), 119 (13), 107 (18) [lit. MS (Bohlmann et al., 1979)]; EI-GC/MS (TMS) *m/z* 488 $[M]^+$ (31), 473 (1), 238 (68), 236 (100), 221 (33), 219 (70), 192 (50), 179 (91). Although our melting point value does not agree with that in the literature, the agreement of the above MS data with that of the literature, together with the product from the unambiguous synthesis procedure, confirms our assigned structure.

Hexadecyl (E)-Ferulate (*C_{16} Ferulate*): mp 85–86 °C; EI-MS *m/z* 418 $[M]^+$ (100), 194 $[M - C_{16}H_{32}]^+$ (49), 177 [acylium]$^+$ (29), 150 $[177 - CO+H]^+$ (11), 137 $[(CH_3O)HOPhCH_2]^+$ (12) [lit. MS (Bernards and Lewis, 1992)]; EI-GC/MS (TMS) *m/z* 490 $[M]^+$ (87), 475 $[M - CH_3]^+$ (8), 460 $[M - 2CH_3]^+$ (5), 266 $[M - C_{16}H_{32}]^+$ (38), 251 $[M - CH_3 - C_{16}H_{32}]^+$ (36), 249 [acylium]$^+$ (71), 236 $[M - 2CH_3 - C_{16}H_{32}]^+$ (66), 222 $[249 - CO + H]^+$ (25), 219 [acylium $- 2CH_3]^+$ (62), 209 $[(CH_3O)TMS - O - PhCH_2]^+$ (46), 207 $[222 - CH_3]^+$ (27), 192 $[219 - CO + H]^+$ (28), 179 $[209 - 2CH_3]^+$ (43).

Octadecyl (E)-Ferulate (*C_{18} Ferulate*): mp 72–74 °C; EI-MS *m/z* 446 $[M]^+$ (48), 194 (100), 177 (55), 150 (28), 137 (38); EI-GC/MS (TMS) *m/z* 518 $[M]^+$ (100), 503 (8), 488 (5), 266 (33), 251 (32), 249 (74), 236 (55), 222 (22), 219 (55), 209 (45), 207 (25), 192 (24), 179 (37).

RESULTS AND DISCUSSION

Latex samples from sweetpotato cultivars Centennial, Jewel, Regal, and Resisto were analyzed for their polyphenolic contents by high-performance liquid chromatography (HPLC) (Figure 1). The HPLC profile revealed several late eluting peaks that required 100% MeOH to elute from the column. Ultraviolet spectra of eluting peaks were obtained with a diode array detector. These data indicated the compounds possessed either coumaric, ferulic, or caffeic acid chromophores. The compounds were isolated by preparative HPLC in four fractions. The individual components of the four fractions were separated by capillary gas chromatography as their trimethylsilyl-derivatives (Figure 2) and identified by GC/MS as fatty alcohol esters of coumaric and ferulic acids.

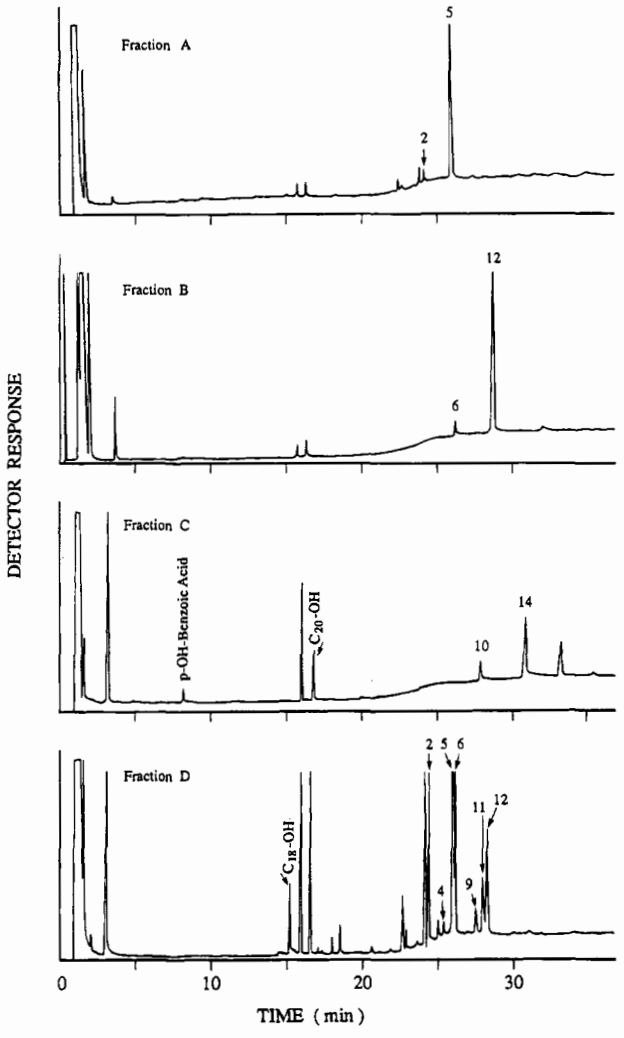


Figure 2. Gas chromatographic profiles (TMS derivatives) of potato vine latex phenolic acid esters isolated in fractions A–D. See Table 1 for peak identifications.

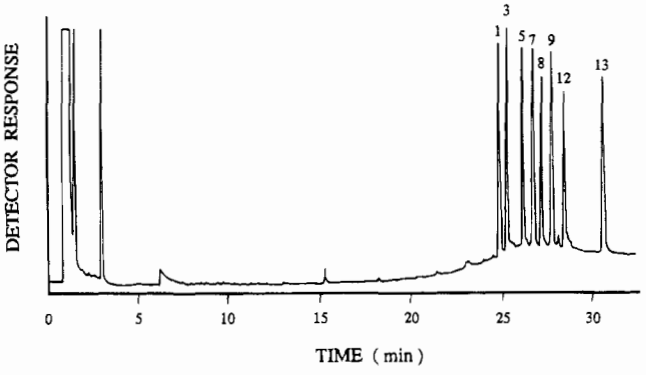


Figure 3. Gas chromatographic separation of synthesized phenolic acid esters (TMS derivatives). See Table 1 for peak identifications.

To more fully characterize the esters present in the fractions, hexadecyl and octadecyl esters of (*E*)-*o*-, -*m*-, and -*p*-coumaric and (*E*)-ferulic acids were synthesized. All isomers were separated by GC as their TMS derivatives (Figure 3). The order of elution of the synthesized esters was *o*-, *m*-, and *p*-coumarates, followed by ferulate for a given alcohol chain length.

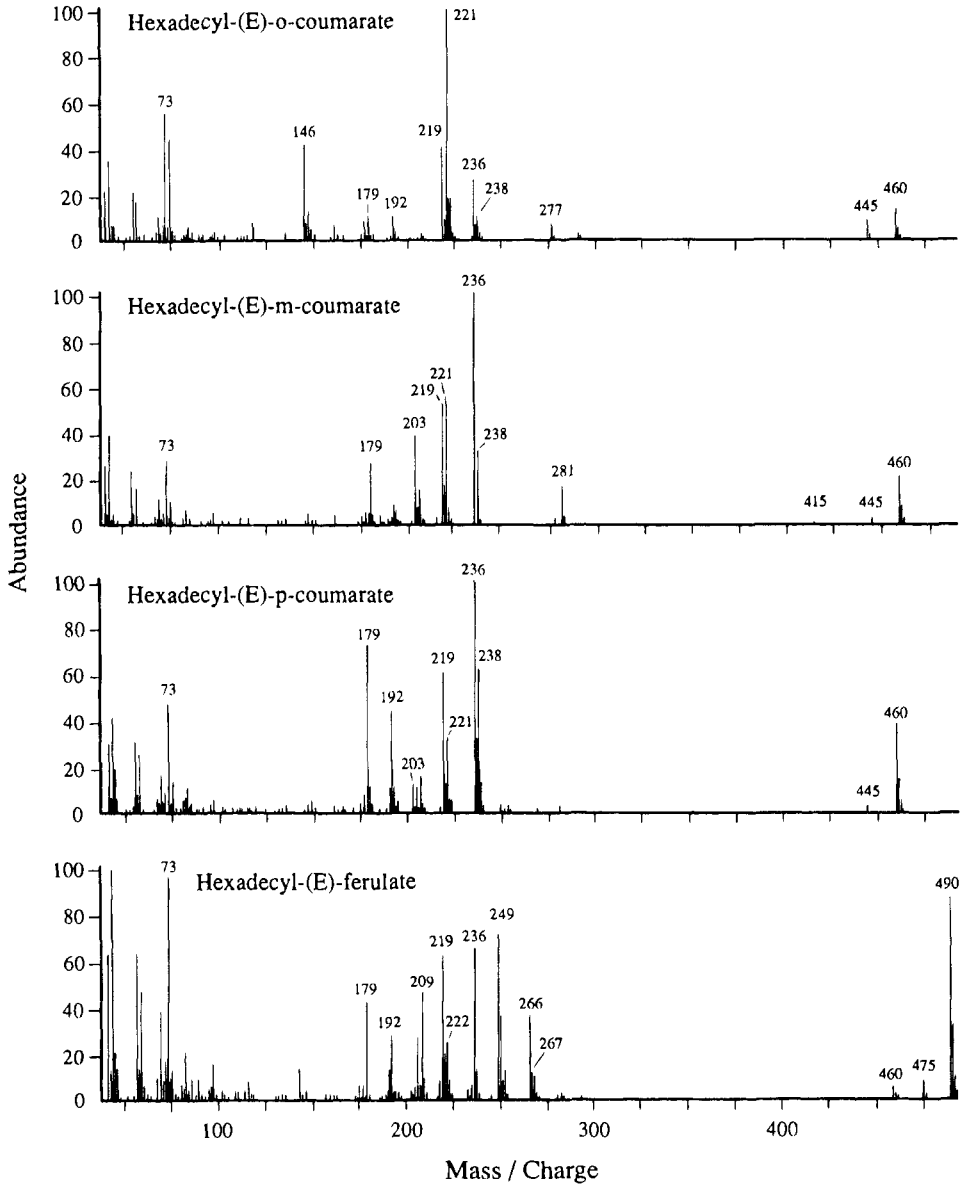


Figure 4. Mass spectra of synthesized hexadecyl coumarates and ferulate.

Mass spectral data of the silyl derivatives of hexadecyl (*E*)-*o*-, -*m*-, and -*p*-coumarates and hexadecyl (*E*)-ferulate are give in Figure 4. Good molecular ions were observed for all compounds, the molecular ion being the base peak for C_{16} ferulate. The MS fragmentation pattern of the o-coumarate ester was very much different from that for the *m*- or *p*-coumarate or ferulate esters. The *m*- and *p*-isomers exhibited well-defined fragmentation to give ions representative of the respective phenolic acids, their acylium ions, and vinyl aromatic derivatives (see Materials and Methods). Ferulate ester fragmentation paralleled that of *p*-coumarate with additional ions corresponding to further loss of methyl. MS fragmentation of the *o*-coumarate esters was guided by the proximity of the o-hydroxy. Whereas the base peak in probe MS of C_{16} *o*-coumarate is 146 amu, corresponding to a facile formation of coumarin, C_{16} TMS-*o*-coumarate exhibited a base peak ion of 221 amu with a much diminished coumarin 146 amu ion. The increased abundance of this ion can be rationalized as shown in Figure 5, where transfer of a methyl group from the silicon atom yields an eight-member cyclic ion. Similar structures are well documented in the mass spectra of *o*-dihydroxy aromatic acids (Horman and Viani, 1971; Morita, 1972; Horvat and Senter, 1980; Snook et al., 1985).

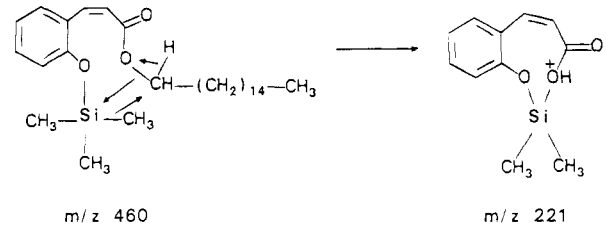


Figure 5. Proposed mass spectral fragmentation pathway of hexadecyl TMS-*o*-coumarate to form the *m*/*z* 221 base peak ion.

The following information was used to confirm that the phenolic components in the natural latex extract consisted mostly of (*E*)-*p*-coumarate esters of C_{16}, C_{18}, and C_{20} alcohols, with only minor amounts of the ferulate esters. Synthesis and GC/MS data showed peaks 5 and 12 (Figures 1 and 2) were the corresponding C_{16} and C_{18} (*E*)-*p*-coumarates while, hydrolysis of peak 5 yielded the expected (*E*)-*p*-courmaric acid and hexadecyl alcohol. Synthesis and GC/MS were also used to characterize C_{16} (*E*)-ferulate (peak 9, Figure 2). All

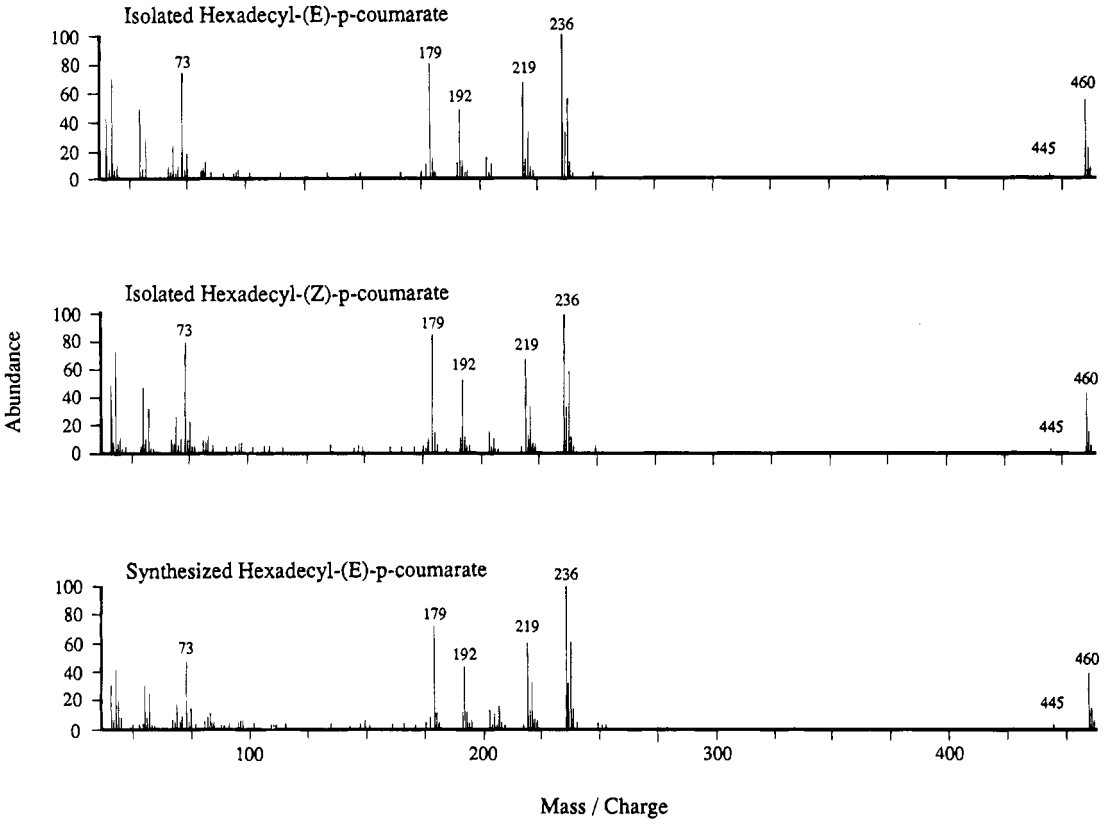


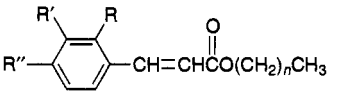
Figure 6. Mass spectra of TMS derivatives of isolated peak 2 (Figure 2) [identified as hexadecyl (*E*)-*p*-coumarate] and peak 5 [identified as hexadecyl (*Z*)-*p*-coumarate] compared to synthesized hexadecyl (*E*)-*p*-coumarate.

other compounds in the natural isolates were characterized by GC/MS data only.

Two peaks were observed in fraction D (Figure 2, peaks 2 and 6) that exhibited GC/MS spectra similar to those of C_{16} and C_{18} (*E*)-*p*-coumarate but did not coelute with the synthetic (*E*)-*o*- or -*m*-coumarates. The TMS-MS spectrum of one of these compounds (peak 2, Figure 2) is given in Figure 6 and compared to isolated and synthesized C_{16} (*E*)-*p*-coumarate and indicates the compound is the *Z*-isomer of C_{16} *p*-coumarate, and similarly peak 6 (Figure 2) would be the C_{18} *Z*-ester and peak 10 (Figure 2) would be the C_{20} *Z*-ester. The MS fragmentation patterns do not indicate these compounds contained branched-chain alcohols (Snook et al., 1984). C_{18} (*Z*)-*p*-coumarate has been identified by IR and NMR spectra in *Chromolaena* species before (Bohlmann et al., 1979). A minor peak in fraction D (peak 11, Figure 2) exhibited a TMS molecular ion of 486 amu and fragment ions identical to those of octadecyl (*E*)-*p*-coumarate (TMS $M^+ = 488$). Consequently, we believe its structure is octadecenyl (*E*)-*p*-coumarate.

HPLC analyses of fractions A and B showed that the less abundant *Z*-isomer eluted just before the *E*-isomer from the reversed-phase column (Figure 1). HPLC is more sensitive for quantitation of these esters than GC. However, we were not able to separate the corresponding (*E*)-*p*-coumarate and ferulate esters by HPLC. Fortunately, in our case, the ferulate esters occur in only minor quantities. Octadecyl *p*-coumarate has been identified in the fruits of *Argyria populifolia* (Gunatilake and Sultanbawa, 1973) and several *Chromolaena* species (Bohlmann et al., 1979). Ferulic acid esters (but not the coumaric esters) have been reported in the stem bark of *Pinus roxburghii* (Chatterjee et al., 1977) and *Pavetta owariensis* (Balde et al., 1991) and in wound-healing potato tubers (Bernards and Lewis, 1992).

Table 1. Synthesized and Isolated Phenolic Acid Esters



$n = 15,17,19$

peak no.[a]	GC retention time (min)	R	R′	R″	compound
1	24.78	OH	H	H	hexadecyl (*E*)-*o*-coumarate[b]
2	25.00	H	H	OH	hexadecyl (*Z*)-*p*-coumarate[c]
3	25.10	H	OH	H	hexadecyl (*E*)-*m*-coumarate[b]
4	25.33	H	OCH_3	OH	hexadecyl (*Z*)-ferulate[c]
5	26.07	H	H	OH	hexadecyl (*E*)-*p*-coumarate[b,c]
6	26.15	H	H	OH	octadecyl (*Z*)-*p*-coumarate[c]
7	26.63	OH	H	H	octadecyl (*E*)-*o*-coumarate[b]
8	27.00	H	OH	H	octadecyl (*E*)-*m*-coumarate[b]
9	27.64	H	OCH_3	OH	hexadecyl (*E*)-ferulate[b,c]
10	28.05	H	H	OH	eicosanyl (*Z*)-*p*-coumarate[c]
11	28.10	H	H	OH	octadecenyl (*E*)-*p*-coumarate[c,d]
12	28.32	H	H	OH	octadecyl (*E*)-*p*-coumarate[b,c]
13	30.45	H	OCH_3	OH	octadecyl (*E*)-ferulate[b]
14	30.85	H	H	OH	eicosanyl (*E*)-*p*-coumarate[c]

[a] Peak numbers refer to peaks on chromatograms (Figures 1–3). [b] Synthesized. [c] Identified in latex. [d] $n = 17$ with one double bond.

Levels of C_{16}, C_{18}, and C_{20} (*E*)- and (*Z*)-*p*-coumarates were determined in the latex of cv. Centennial, Jewel, Regal, and Resisto sweetpotatoes by HPLC. Results are given in Table 1. C_{18} (*E*)-*p*-coumarate was found to occur in greatest abundance in all cultivars, ranging from about 0.7% fresh weight to almost 2%. The ratio of C_{16}, C_{18}, and C_{20} *E*-isomers (0.22–0.31:1.0:0.16–0.27) was very consistent for all cultivars. Levels of the *Z*-isomers were found to be only $^1/_{10}$ to $^1/_{20}$ of the corresponding *E*-isomer levels.

Root latex of cv. Jewel sweetpotato was also analyzed by HPLC (Table 1). Root latex was much more viscous

Table 2. Levels of Fatty Alcohol *p*-Coumarates in Latex of Sweetpotato Varieties

variety	% fresh weight[a]					
	(*Z*)-C_{16}	(*E*)-C_{16}	(*Z*)-C_{18}	(*E*)-C_{18}	(*Z*)-C_{20}	(*E*)-C_{20}
vine latex						
Regal	0.018	0.336	0.072	1.090	0.014	0.170
Resisto	0.033	0.155	0.162	0.685	0.051	0.189
Centennial	0.008	0.238	0.034	0.926	0.011	0.144
Jewel	0.015	0.408	0.128	1.840	0.040	0.411
root latex						
Jewel	0.333	4.77	0.703	4.69	0	0.136

[a] Average of three replications.

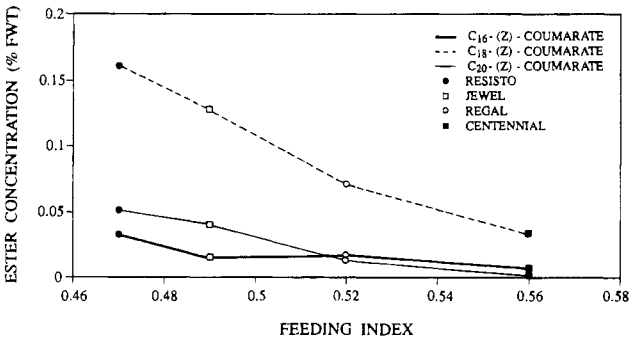


Figure 7. Relationship between the concentration of *Z*-ester isomers in the latex of the four sweetpotato cultivars and the relative attractiveness of their leaves for feeding by the sweetpotato weevil (C_{16}, $y = 0.56778 - 3.123X$, $R^2 = 0.71$; C_{18}, $y = 0.57712 - 6.678X$, $R^2 = 0.98$; C_{20}, $y = 0.55419 - 1.6677X$, $R^2 = 0.96$).

than vine latex, and this was reflected in the higher percent fresh weight of the phenolic esters. C_{16} (*E*)-*p*-coumarate percent fresh weight was found to be 12–30-fold the level in vine latex, while C_{18} (*E*)-*p*-coumarate increased by 2.5 to almost 7-fold.

Levels of individual *Z*- and *E*-isomers were correlated with the leaf feeding indices (Nottingham et al., 1988) for the four test cultivars (length of vein eaten divided by the total length of vein within the test area). While the correlations of the *E*-isomers were very poor (data not shown), the levels of *Z*-isomers correlated extremely well with the attractiveness of the foliage for feeding (Figure 7). R^2 values were as follows: $C_{20} = 0.96$; $C_{18} = 0.98$; and $C_{16} = 0.71$. As the concentration of the Z-isomer increased, the leaves became progressively less attractive for feeding. The total concentration of each of the *Z*-isomers was quite low and may in part account for the leaves being relatively acceptable to the weevils as a food source. Existing levels of resistance to the sweetpotato weevil found in two of the cultivars used in the current study appear to be primarily due to the absence of an ovipositional stimulant on the surface of the storage roots (Wilson et al., 1990). Evidence to date does not support a deterrent role for sweetpotato latex per se (Data and Kays, unpublished data); however, individual components within the latex may exhibit biological activity with reference to weevil activity and thus could potentially be exploited in a weevil resistance plant breeding program. The significant correlations between certain components within the latex and acceptability of the leaf for feeding reported herein are encouraging and warrant further investigation. We intend to assess the influence of specific latex components via a feeding bioassay that utilizes an artificial medium, thus allowing precise control over the composition of the material presented to the insect (Kays et al., 1993).

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