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Note

Analysis of cinnamon oils by high-pressure liquid chromatography

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The two main species of cinnamon used commercially for their essential oil are *C. zeylanicum* and *C. cassia*. *C. zeylanicum* affords cinnamon bark oil and cinnamon leaf oil. These oils are of great economic importance and a large number of countries are involved in their production[1]. Quality control of these materials is important as the nature of the oil varies with geographical source and method of production[2].

The oils are frequently analysed for phenols (expressed as eugenol) and aldehydes (expressed as cinnamaldehyde)[3]. Gas–liquid chromatography (GLC) has also been used to analyse cinnamon oils[2,4,5], and cassia oil has been subjected to detailed qualitative analysis by specific extraction procedures followed by GLC–mass spectrometry (MS) revealing the presence of 35 compounds[6].

The major components of the cinnamon oils are aromatic and therefore suitable candidates for analysis by high-pressure liquid chromatography (HPLC) using UV detection. The most important distinguishing feature is the cinnamaldehyde and eugenol content, typical levels being quoted as: cinnamon bark oil, cinnamaldehyde 55–75%, eugenol 5–18%; cinnamon leaf oil, cinnamaldehyde 1–8%, eugenol 65–95%; cassia oil, cinnamaldehyde 70–95%, depending on the geographical source. As cinnamon bark oil is by far the most expensive of the three it is frequently adulterated with the other oils or with synthetic cinnamaldehyde. This adulteration can be detected by analysis of the cinnamaldehyde and eugenol content.

EXPERIMENTAL

Analyses were performed at ambient temperature on a 3 ft. × 0.085 in. I.D. stainless-steel column packed with Corasil Type II (Waters Assoc., Milford, Mass., U.S.A.), particle size 37–50 μm. The eluent flow-rate was 1.0 ml/min generated by a 6000M solvent delivery system (Waters Assoc.). Quantitative analyses were performed isocratically using 1% ethyl acetate (BDH, Poole, Great Britain; Product No. 28311) in cyclohexane (BDH Product No. 27867) and qualitative analyses were carried out using gradient elution from cyclohexane to 40% ethyl acetate in cyclohexane (Fig. 2). Sample size for qualitative analysis was 10 μl of 100 μl/ml neat oil in 5% ethyl acetate in cyclohexane. An UV spectrophotometer (Cecil Instruments CE 272 with modified flow cell) monitoring at 260 nm was used as detector.

Components were identified by comparison with authentic compounds, *viz.*

benzaldehyde, eugenol, cinnamaldehyde, cinnamyl acetate, cinnamyl alcohol and eugenol acetate.

RESULTS

Cinnamaldehyde and eugenol could be easily separated on Corasil II columns using 1 % ethyl acetate in cyclohexane as eluent (Fig. 1). The construction of calibration curves (both linear over the concentration range used) allowed the determination of the cinnamaldehyde content of a number of commercial oil samples (Table I). Using a stop-flow injection technique peak heights were found sufficiently reproducible for assay purposes.

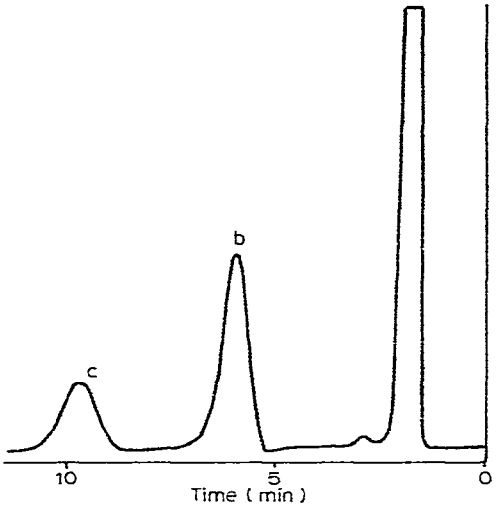

Fig. 1. Separation of eugenol (b) and cinnamaldehyde (c) in cinnamon leaf oil by isocratic development.

TABLE I

CINNAMALDEHYDE AND EUGENOL CONTENTS OF CINNAMON OILS

Oil	*Cinnamaldehyde (%, v/v)*	*Eugenol (%, v/v)*
Cinnamon bark oil	76.5	2.5
Cinnamon bark oil	56.4	6.1
Cinnamon leaf oil	3.1	87.5
Cinnamon leaf oil	2.2	80.7
Cassia oil	80.0	1.3
Cassia oil	81.5	6.3

Gradient elution from cyclohexane to 40% ethyl acetate in cyclohexane revealed the presence of a number of other aromatic compounds some of which have been provisionally identified on the basis of comparative retention times of authentic compounds (Figs. 2–4).

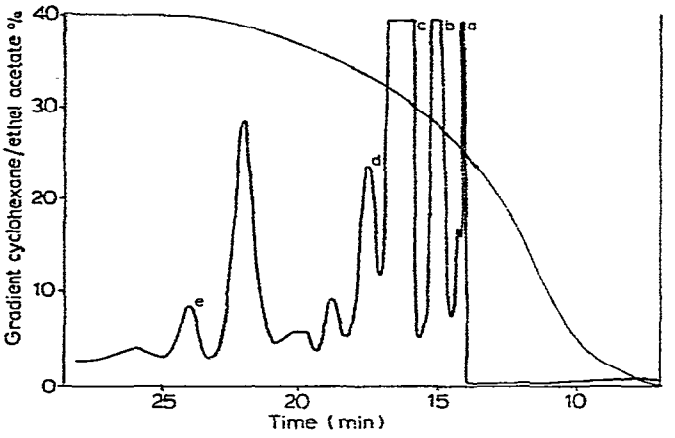

Fig. 2. Gradient elution HPLC of cinnamon bark oil. a = Benzaldehyde; b = eugenol; c = cinnamaldehyde; d = cinnamyl acetate; e = cinnamyl alcohol.

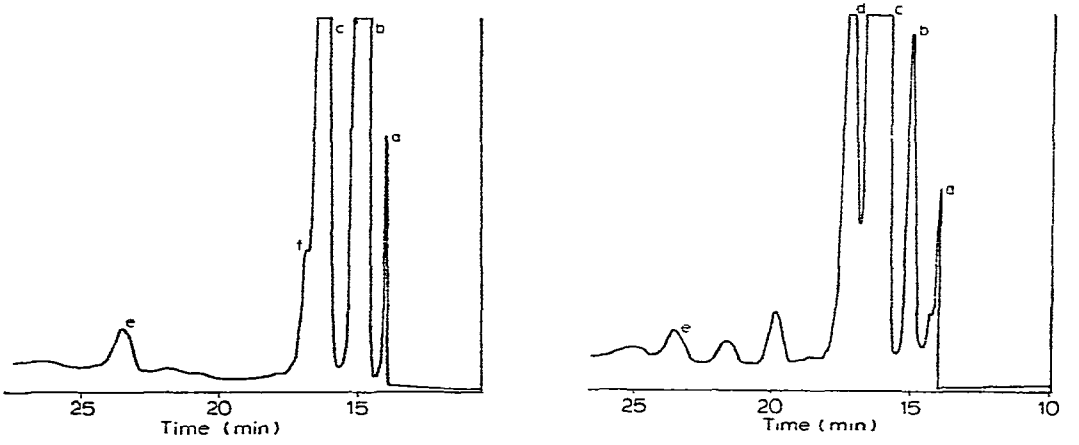

Fig. 3. Gradient elution HPLC of cinnamon leaf oil. a = Benzaldehyde; b = eugenol; c = cinnamaldehyde; d = cinnamyl acetate; e = cinnamyl alcohol; f = eugenol acetate.

Fig. 4. Gradient elution HPLC of cassia oil. a = Benzaldehyde; b = eugenol; c = cinnamaldehyde; d = cinnamyl acetate; e = cinnamyl alcohol.

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