

be fed into the instrument, so programmed as to permit establishment of the retention time-peak height relationship, correction factors, conversion of these data to weight percentages, and even designation of constituents present. Closely related and equally valuable authenticating criteria, such as sample purity and geographical provenance established on the basis of characteristic constituent ratios, could thus likewise be determined not only for essential oils but other natural and synthetic preparations amenable to similar analyses.

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### Literature Cited

- (1) Blumann, A., Zeitschel, O., *Ber.* **47**, 2623 (1914).
- (2) British Pharmaceutical Codex. p. 714, The Pharmaceutical Press, London, 1959.
- (3) "British Standard Specifications, Essential Oils," p. 31, British Standards Institution, London, 1958.
- (4) Deussen, E., *J. Prakt. Chem.* **90**, (2), 318 (1914).

- (5) Foods and Drugs Act and Regulations, Section B.10.022, Queen's Printer and Controller of Stationery, Ottawa, Canada, 1954.
- (6) Gildemeister, E., Hoffmann, F., "Die Atherischen Öle," 3rd ed., Vol. 1, p. 556, Schimmel and Co., Leipzig, Germany, 1928.
- (7) Gronovius, J. F., "Flora virginica exhibens plantas quas v. c. Johannes Clayton," 1st ed., Cornelius Haak, Leyden, 1739.
- (8) Guenther, E., "The Essential Oils," Vol. 1, pp. 283-4, Van Nostrand, New York, 1948.
- (9) *Ibid.*, pp. 50-77.
- (10) *Ibid.*, Vol. 3, pp. 681-3.
- (11) Guenther, E., *Perfumery Essent. Oil Record* **52**, (11), 695 (1961).
- (12) Hocking, G. M., *J. Am. Pharm. Assoc. Sci. Ed.* **38**, 394 (1949).
- (13) "Methodes d'Analyse et Constantes Analytiques des Huiles Essentielles," 2nd ed. p. 71, Syndicat des Fabricants et Importateurs d'Huiles Essentielles et Produits Aromatiques Naturels, Grasse, France.
- (14) Murray, M. J., A. M. Todd Co., Kalamazoo, Mich., private communication, July 14, 1961.
- (15) "National Formulary," 11th ed., p. 344, American Pharmaceutical Association, Washington 7, D. C., 1960.
- (16) Oregon Crop and Livestock Reporting Service, U. S. Department of Agriculture, December 1960.
- (17) Reitsema, R. H., *J. Am. Pharm. Assoc. Sci. Ed.* **43**, 414 (1954).
- (18) *Ibid.*, **47**, 267 (1958).
- (19) Reitsema, R. H., Cramer, F. J., Scully, N. J., Chorney, W., *J. Pharm. Sci.* **50**, 18 (1961).
- (20) Reitsema, R. H., Fass, W. E., *J. Am. Pharm. Assoc. Sci. Ed.* **46**, 381 (1957).
- (21) Small, L. D., Dusenberry, J. E., Gloor, W. T., *Ibid.*, **41**, 280 (1952).
- (22) Smith, D. M., Campbell, R. G., *Chemist-Analyst* **50**, 80 (1961).
- (23) Smith, D. M., Levi, L., *J. Agr. Food Chem.* **9**, 230 (1961).
- (24) Tandy, R. K., Lindgren, F. T., Martin, W. H., Wills, R. D., *Anal. Chem.* **33**, 665 (1961).
- (25) Wallach O., *Ann. Chem.* **305**, 224 (1899).

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### Addendum

#### Sabinene Hydrate and Sabinene Acetate: Two New Constituents of American Spearmint Oil

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THE OCCURRENCE of a peak emerging between 3-octanol and menthone

<sup>1</sup> National Research Council of Canada Postdoctorate Fellow, 1962.

in spearmint oil gas chromatograms and permitting reliable distinctions between *Mentha spicata* and *M. cardiaca* was reported in the previous paper (5). Experiments completed recently established that this peak (marked 7) is generated largely by two components—*trans*-sabinene hydrate and *trans*-sabinene acetate. The tertiary alcohol is known to occur in American peppermint oil (0.8%) (2), but was not yet detected in any other essential oil. The ester has so far not been found in nature. Characteristic criteria of identity of the compounds were assembled by gas chromatography (Ucon, Reoplex, and SAIB substrates) and comparison of infrared analyses of effluents with recorded data (1-3).

Marked decomposition of both terpenoids to phellandrene ( $\alpha$ - and  $\beta$ -isomer), terpinene ( $\alpha$ - and  $\gamma$ -isomer), and other hydrocarbons occurred during gas chromatography. Formation of these degradation products from sabinene, sabinene hydrate, and sabinene acetate at elevated temperatures has been reported (2,4).

The analytical peak was observed and found to be of similar composition in gas chromatograms of American peppermint oils. The presence of the ester in *M. piperita* was thus also established for the first time.

### Literature Cited

- (1) Daly, J. W., Ph.D. thesis, Dept. of Chemistry, Stanford University, Stanford, Calif., March 1958.
- (2) Daly, J. W., Green, F. C., Eastman, R. H., *J. Am. Chem. Soc.* **80**, 6330 (1958).
- (3) Green, F. C., Ph.D. thesis, Dept. of Chemistry, Stanford University, Stanford, Calif., March 1950.
- (4) Mitzner, B. M., Theimer, E. T., *J. Org. Chem.* **27**, 3359 (1962).
- (5) Smith, D. M., Skakum, W., Levi, L., *J. Agr. Food Chem.* **11**, 268 (1963).

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### Correction

#### Biuret Formation in the Manufacture of Urea

In this article by P. J. C. Kaasenbrood, P. J. van den Berg, and L. J. Revallier [*J. Agr. Food Chem.* **11**, 39 (1963)], the ordinate and abscissa labels were omitted from Figures 3 and 4 on page 42. The ordinate label for Figure 3 should read

→ % BY WEIGHT OF BI CALCD. ON U + Bi

and for figure 4

→ % BY WEIGHT OF NH<sub>2</sub> CALCD. ON U + Bi + NH<sub>2</sub>

The abscissa labels for both figures should read

→ p<sub>NH<sub>2</sub></sub> IN ATM.