

ASARININ IN *ACRONYCHIA MUELLERI* W. D. FRANCIS

By J. B. DAVENPORT* and M. D. SUTHERLAND†

[Manuscript received July 26, 1954]

Summary

(+)-Asarinin has been found in the leaves of *Acronychia muelleri* W. D. Francis. An anomaly in the ultraviolet absorption of asarinin and of its diastereoisomer sesamin is discussed.

I. INTRODUCTION

(+)-Asarinin has been found in the leaves of *Acronychia muelleri* W. D. Francis, a tree of the family Rutaceae which grows in the north Queensland rain-forests. The (+)-form has not previously been found in plants, although the (-)-form occurs in *Asarum blumei* Duch. (Huang-Minlon 1937), *A. sieboldii* Miq. (Chou and Chu 1935), *Xanthoxylum carolianum* Lam. (Dieterle and Schwengler 1939) and *X. clava-herculis* L. (La Forge and Barthel 1944). (+)-Asarinin has been previously obtained by the isomerization of (+)-sesamin isolated from sesame oil and our material from *A. muelleri* appears to differ in no significant way from the literature description of (+)-asarinin. It is apparently unusual for lignanes to occur in leaves (Haworth 1942), as in this instance.

A difficulty met in measuring the ultraviolet absorption of asarinin with a Beckman DU spectrophotometer is of interest. It was found that the extinction coefficients at the maxima differed very considerably when calculated from optical densities measured on solutions of different concentrations. A plot of optical density *versus* concentration for a number of wavelengths (Fig. 1) showed that as the concentration increased, the density lost its proportionality to the concentration and finally became independent. Similar behaviour is shown by several fluorescent substances investigated by Braude, Fawcett, and Timmons (1950), including styryldimethyl carbinol which resembles asarinin in showing no fluorescence in the visible region. This phenomenon has recently been fully discussed (Braude and Timmons 1953; Ovenston 1953).

Although recent papers describing a spectrophotometric method for the determination of sesamin in sesame oil (Budowski, O'Connor, and Field 1951; Suarez *et al.* 1952) made no mention of this phenomenon, examination has revealed that the behaviour of sesamin (Fig. 1) is similar to that of asarinin. Erroneous values for sesamin content would result from the use of solutions of high optical density only.

* Division of Food Preservation and Transport, C.S.I.R.O., Homebush, N.S.W.

† Chemistry Department, University of Queensland.

II. EXPERIMENTAL

Melting points are uncorrected.

(a) *Isolation of (+)-Asarinin.*—The powdered leaves (25 g) containing 10.8% moisture (loss on heating at 100 °C for 2 hr) were exhaustively extracted with benzene in a Soxhlet apparatus and the extract was chromatographed on alumina. The eluate was collected in fractions of approximately 50 ml and each was evaporated and examined separately. The earlier fractions contained a white amorphous solid which, after several recrystallizations from ethanol and from acetone, sintered at 62 °C and melted at 73 °C, the yield being 10 mg (Found: C, 82.1, 81.9; H, 13.7, 14.0%). Following this, asarinin was obtained in a fairly pure state, the yield being 164 mg (0.66%). A more strongly absorbed substance of m.p. 126.5–127 °C was next eluted and will be reported on separately.

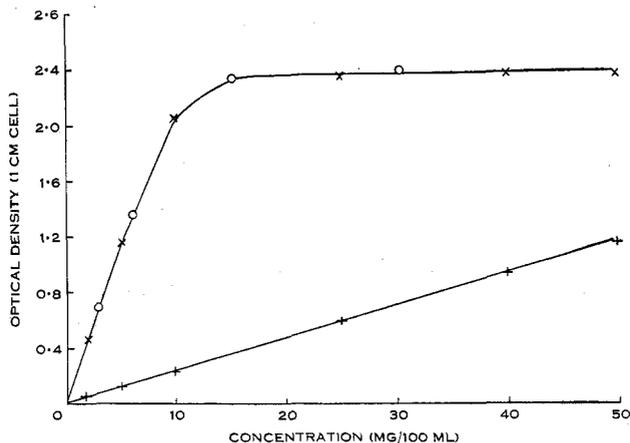


Fig. 1.—The effect of concentration on optical density.

- ×—× Asarinin at 287 mμ.
 +—+ Asarinin at 255 mμ.
 o—o Sesamin at 287 mμ.

Larger quantities were obtained as follows: the leaves were exhaustively extracted with benzene. On standing the benzene extract deposited crystals of the substance of m.p. 126.5–127 °C. Upon concentration of the mother liquors, asarinin crystallized and was filtered off. Recrystallization from ethanol yielded white needles, m.p. 120–121 °C, $[\alpha]_D^{28} +117 \pm 1^\circ$ (c, 3.7 in chloroform) (Found: C, 67.8, 67.5; H, 5.2, 5.5; mol. wt., 334, 340, 361; λ_{\max} , 235 mμ; $\log \epsilon_{\max}$, 3.97; λ_{\max} , 288 mμ; $\log \epsilon_{\max}$, 3.92; calculated from acceptable values of optical density. Calc. for $C_{20}H_{18}O_6$: C, 67.8; H, 5.1%; mol. wt., 354).

It gave a strong red colour with conc. sulphuric acid, a strong brownish yellow colour with tetranitromethane, failed to decolorize bromine, gave a negative test for primary and secondary hydroxyl groups (Fearon and Mitchell 1932), contained no methoxyl groups, and could not be acetylated. For (+)-asarinin, Huang-Minlon (1937) records m.p. 121–122 °C and $[\alpha]_D^{18} +121.7^\circ$ in chloroform.

Material from the crude benzene extract once recrystallized from ethanol gave $[\alpha]_D^{28} +117 \pm 1^\circ$ (c, 3.4 in chloroform) indicating that asarinin was not accompanied by (–)-asarinin or sesamin.

(b) *Isomerization to Sesamin.*—(+)-Asarinin (5 g), conc. hydrochloric acid (50 ml), and ethanol (450 ml) were refluxed together for 16 hr. By refrigeration, 2.12 g of unchanged material were recovered. The concentrated mother liquor yielded a further 1.99 g of material which was recrystallized from ethanol to m.p. 121–122 °C, $[\alpha]_D^{26.5} +67 \pm 1^\circ$ (c, 0.7 in chloroform), mixed m.p. with (+)-asarinin 98–105 °C. Huang-Minlon (1937) finds m.p. 121–122°, $[\alpha]_D^{18}$

-68.9° (in chloroform) for (-)-sesamin, and Kaku, Kutami, and Takahashi (1936), m.p. 123-124 °C, $[\alpha]_D^{19} + 68.1^\circ$ (in chloroform) for (+)-sesamin.

(c) *Dinitroasarinin*.—Asarinin was nitrated below 45 °C in glacial acetic acid with conc. nitric acid. Dinitroasarinin was precipitated with water, filtered, and recrystallized from dioxane and finally glacial acetic acid to constant m.p. 224.0-226.5 °C, $[\alpha]_D^{27} - 25 \pm 1^\circ$ (c, 4.7 in chloroform). Kaku, Kutami, and Takahashi (1936) record m.p. 220-221 °C, $[\alpha]_D^{17} - 29.5^\circ$ (Found: C, 54.2; H, 3.6%. Calc. for $C_{20}H_{16}O_{10}N_2$: C, 54.0; H, 3.6%).

(d) *4-Nitro-1,2-Methylenedioxybenzene*.—Asarinin (2 g) dissolved in glacial acetic acid and conc. nitric acid (5 ml) was heated on a water-bath. Dinitroasarinin (0.68 g) was filtered off, and water was added to the filtrate, precipitating 0.8 g of 4-nitro-1,2-methylenedioxybenzene. Crystallization from ethanol and from acetone yielded yellow needles, m.p. 147-148 °C. Huang-Minlon (1937) records m.p. 146-147 °C (Found: C, 50.1; H, 3.2%. Calc. for $C_7H_5O_4N$: C, 50.3; H, 3.0%).

III. ACKNOWLEDGMENTS

The authors are indebted to Mr. L. J. Webb, Division of Plant Industry, C.S.I.R.O., for collecting and identifying the plant material.

IV. REFERENCES

- BRAUDE, E. A., FAWCETT, J. S., and TIMMONS, C. J. (1950).—*J. Chem. Soc.* **1950**: 1019.
BRAUDE, E. A., and TIMMONS, C. J. (1953).—Photoelect. Spectr. Gr. Bull. No. 6: 139.
BUDOWSKI, P., O'CONNOR, R. T., and FIELD, E. T. (1951).—*J. Amer. Oil Chem. Soc.* **28**: 51.
CHOU, T. Q., and CHU, J. H. (1935).—*Chin. J. Physiol.* **9**: 261.
DIETERLE, K., and SCHWENGLER, K. (1939).—*Arch. Pharm. Berl.* **277**: 33.
FEARON, W. R., and MITCHELL, D. M. (1932).—*Analyst* **57**: 372.
HAWORTH, R. D. (1942).—*J. Chem. Soc.* **1942**: 448.
HUANG-MINLON (1937).—*Ber. dtsh. chem. Ges.* **70**: 951.
KAKU, T., KUTAMI, N., and TAKAHASHI, J. (1936).—*J. Pharm. Soc. Japan* **56**: 361.
LA FORGE, F. B., and BARTHEL, W. F. (1944).—*J. Org. Chem.* **9**: 250.
OVENSTON, T. C. J. (1953).—Photoelect. Spectr. Gr. Bull. No. 6: 132.
SUAREZ, C., O'CONNOR, R. T., FIELD, E. T., and BICKFORD, W. G. (1952).—*Analyt. Chem.* **24**: 668.