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NAPHTHOQUINONE DERIVATIVES FROM LITHOSPERMUM ERYTHROHIZON SIEBOLD ET ZUCCARINI

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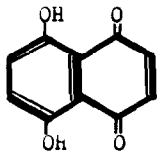
The roots of Lithospermum erythrohizon Sib. et Zucc. (Japanese name: Shikon) have been widely used as a dye or a drug in Japan. Coloring matters were isolated from benzene extracts of the root. One of the coloring matters was identified as monoacetyl-shikonin which had been reported by Majima and Kuroda(1). Two new naphthoquinone derivatives were further isolated from the extracts. One was isobutyl-shikonin(I) and another was ββ-dimethylacryl-shikonin(II), and this conclusion was established on the following evidences.



R: $COCH(CH_3)_2$ (I)
R: $COCH{:}C(CH_3)_2$ (II)
R: H (III)

Isobutyl-shikonin(I), m.p. 89-90°, $[\alpha]_{600}^{23}$ + 125° (ethanol), was assigned the formula $C_{20}H_{22}O_6$(Anal. Calcd.: C, 67.02; H, 6.17; Found: C, 66.29; H, 6.07). The molecular formula of I was confirmed by mass spectrometry with a molecular ion peak at m/e 358(Calcd. 358.176)(2), and the infrared (ν_{max}^{KBr} 1735 cm^{-1}/OCOCH$(CH_3)_2$/, 1610 cm^{-1}/CO/, L450 cm^{-1}, 760 cm^{-1}), ultraviolet($\lambda_{max}^{ethanol}$ 273 mμ, log ε 4.25) and n.m.r. spectra(2 aromatic H, 7.20 ppm; 1 aromatic H, 6.99 ppm; 1 olefinic H as triplets centered at 6.05 ppm; 6 isopropenyl methyl H, 1.63-1.73 ppm; 6 isobutyl H, 1.20-1.33 ppm; 2 allyl H as quartets centered at 2.60 ppm; 1 vinyl H as triplets centered at 5.17 ppm), respectively.

Further confirmation was obtained by alkaline hydrolysis of I (2% NaOH, room temperature) affording shikonin(III) $C_{16}H_{16}O_5$(m.p. 147-149° , Anal. Calcd.: C, 66.66; H, 5.59; Found: C, 65.87; H, 5.51) and isobutyric acid. Isobutyric acid was identified by paperchromatography using a mixture of butanol-2.5% aqueous ammonia(1:1) as solvent. The acid gave the same Rf value(0.22) with that of an authentic sample.

ββ-dimethylacryl-shikonin(II), m.p. 113-114°, $[\alpha]_{600}^{22}$ + 222°(ethanol), was assigned the formula $C_{21}H_{22}O_6$ (Anal. Calcd.: C, 68.09; H, 5.99; Found: C, 67.70; H, 5.78). The molecular formula was confirmed by mass spectrometry with a molecular ion peak at m/e 370(Calcd., 370.176), and the infrared(ν_{max}^{KBr} 1710 cm^{-1}/OCOCH:C$(CH_3)_2$/, 1612 cm^{-1}/CO/,

1455 cm^{-1}, 760 cm^{-1}), ultraviolet($\lambda_{max}^{ethanol}$ 273 mμ, log ε, 3.87), and n.m.r. spectra(2 aromatic H, 7.20 ppm; 1 aromatic H, 7.11 ppm; 1 olefinic H, 5.80 ppm; 6 ββ-dimethylacrylic H, 1.97-2.20 ppm; 6 isopropenyl methyl H, 1.63-1.73 ppm; 1 olefinic H as triplets centered at 6.05 ppm; 1 vinyl H as triplets centered at 2.60 ppm), respectively. Strong absorption at 1710 cm^{-1} which is ascribed to carbonyl group indicates the presence of αβ-unsaturated group.

Furthermore, shikonin and ββ-dimethylacrylic acid (Rf, 0.36) were obtained from II by the alkaline hydrolysis. The Rf value of ββ-dimethylacrylic acid was identified with an authentic sample prepared by the reaction of malonic acid with acetone in the presence of acetic anhydride.

Thus, structure of (I) and (II) are assigned, respectively, for the two compouns isolated from the benzene extracts of the root of Lithospermum erythrohizon Sib. et Zucc.

REFERENCES

1. Majima, Kuroda, Acta phytochim. 1 43(1922).
2. The authors are indebted to Dr. A. Tatematsu for this measurements.
3. The n.m.r. spectra were taken in deutrochloroform with tetramethylsilane as internal standard on a Varian A-60 spectrometer. The authors wish to thank Takeda Pharmaceutical Co., Ltd. for the elemental analyses and for the n.m.r. spectral data.