Tetrahedron Letters No. 29, pp 2539 - 2540, 1976. Pergamon Press. Printed in Great Britain.

LICODIONE, A NEW DIBENZOYLMETHANE DERIVATIVE FROM CULTURED CELLS OF GLYCYRRHIZA ECHINATA[1]

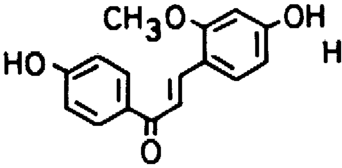
Tsutomu Furuya*, Shin-ichi Ayabe and Miyuki Kobayashi
School of Pharmaceutical Sciences, Kitasato University
Shirokane, Minato-ku, Tokyo, 108 Japan

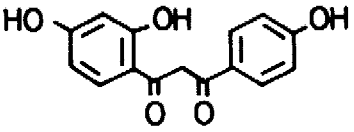
(Received in Japan 5 April 1976; received in UK for publication 10 June 1976)

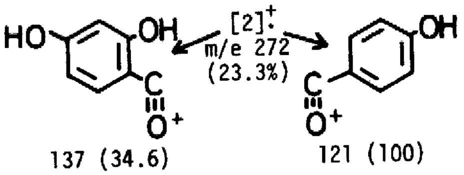
From the cultured cells of Glycyrrhiza echinata (Leguminosae), echinatin[2] (1), a chalcone with unusual dispositions of O-substitutions, has been isolated and a new biosynthetical scheme of retrochalcone has been proposed[3]. Three additional phenolic compounds, one of them new, were isolated from the same cultured cells. The new compound, named licodione (2), was a dibenzoylmethane derivative and the others were two flavones, 7,4'-dihydroxyflavone and licoflavone A[4] (7,4'-dihydroxy-6-γ,γ-dimethylallylflavone). Now we would like to report the structural elucidation of 2 in this paper.

Licodione (2) gave deep yellow needles (54 mg, 0.0003% yield of the fresh cultured cells), m.p.152-153° (decomp.), $C_{15}H_{12}O_5$ (M^+ 272.064). Its UV spectrum, λ_{max}^{MeOH} nm (log ε): 285 (4.3), 376 (4.6), $\lambda_{max}^{MeOH-NaOMe}$ nm (log ε): 242 (4.1), 342 (4.7), 415 (4.2) and IR spectrum, ν_{max}^{KBr} cm^{-1}: 3380 (OH), 1625sh. and 1600 br. (C(OH)=CH-C=O), indicated evidently the presence of β-hydroxychalcone structure. The predominant peaks in mass spectrum, m/e 137.024 ($C_7H_5O_3$, 34.6%) and m/e 121.031 ($C_7H_5O_2$, 100%), revealed the existence of mono- and dihydroxybenzoyl groups in the structure. The chemical degradation of 2 with 5% KOH/EtOH (reflux, 5 min.) gave four compounds, i.e. resacetophenone, p-hydroxyacetophenone, β-resorcylic acid and p-hydroxybenzoic acid. These data lead to the conclusion that the structure of 2 is 1-(2,4-dihydroxyphenyl)-3-(4-hydroxyphenyl)-1,3-propanedione. Licodione is readily cyclized with acid by the loss of H_2O to form 7,4'-dihydroxyflavone and this fact well explains the dark red color on treatment of 2 with Mg-HCl and bright blue spot sprayed with H_2SO_4 under UV lamp[5].

Licodione was also identical with synthetic sample which was afforded on condensation of resacetophenone and p-benzoyloxybenzoyl chloride with K_2CO_3 followed by hydrolysis with cold 1% KOH/EtOH.


1


2



The co-occurrence of licodione (2) with echinatin (1) in the cultured cells indicates an important role of dibenzoylmethane in retrochalcone biosynthesis, in which the following oxidation-reduction process is assumable; hydroxylation of ß-position of isoliquiritigenin to form 2 and elimination of the oxygen originated from the carboxyl group of cinnamic acid, accompanied with O-methylation step.

The presence of 2 in the root of original plant was also observed on TLC.

Feeding experiment with isotopic licodione is now in progress.

Acknowledgement -- We are grateful to Prof. S.Shibata, Faculty of Pharmaceutical Sciences, University of Tokyo, for his supply of a sample of licoflavone A. This work was supported in part by the Grant-in-Aid for Scientific Research from the Ministry of Education of Japan which is gratefully acknowledged.

REFERENCES AND NOTES

1) Part 29 in the series "Studies on Plant Tissue Cultures". For Part 28, see M.Hirotani and T.Furuya, Physiologia Plantarum, in press (1976).

2) T.Furuya, K.Matsumoto and M.Hikichi, Tetrahedron Lett., 1971, 2567.

3) T.Saitoh, S.Shibata, U.Sankawa, T.Furuya and S.Ayabe, Tetrahedron Lett., 1975, 4463.

4) S.Shibata and T.Saitoh, personal communication.

5) Proton NMR spectrum of licodione was not able to be used for structural elucidation because it reveals the pattern of the mixture of diketonic (40%) and its tautomer, enolic form (60%) in DMSO solution at r.t.-50° ($\delta^{\text{DMSO-d6}}_{\text{TMS}}$ 4.61(0.8H, s, CO-C$\underline{H}_2$-CO), 7.01(0.6H, s, C(OH)=C$\underline{H}$-CO)). Aromatic protons, 6.32(1H, d, J = 2 Hz), 6.43(1H, d, J = 9 Hz), 6.91(2H, dd, J = 8 and 2 Hz), signals in lower field (integrate 3H) seem likely overlapped pattern of 7.72(d, J = 9 Hz), 7.87(d, J = 8 Hz), 7.91(d, J = 8 Hz) and 7.95(d, J = 9 Hz).