The Synthesis of Elliptol Isoflavone

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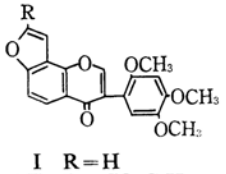
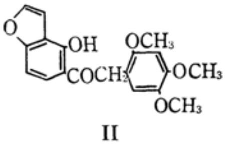
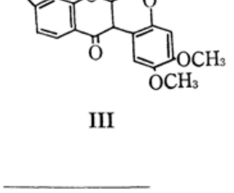
In 1942, elliptol isoflavone (furano(2″, 3″; 7, 8)-2′, 4′, 5′-trimethoxyisoflavone) (I) was prepared by Harper1) from elliptol methyl ether (II)2), a degradative fragment of elliptone (III)3). As I belongs to the same isoflavone type as Harper's phenol ("toxicarol isoflavone")4), which has been isolated from the *Derris elliptica* root along with other rotenoids, I has attracted increasing attention. As described in a previous paper5), 7-hydroxy-2′, 4′, 5′-trimethoxyisoflavone (IV) was produced from 2, 4-dihydroxyphenyl 2, 4, 5-trimethoxybenzyl ketone. Now we will describe a total



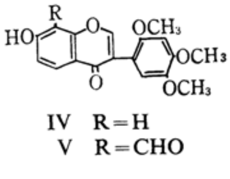
I R=H
VI R=$CO_2C_2H_5$
VII R=CO_2H



II



III



IV R=H
V R=CHO

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1) S. H. Harper, *J. Chem. Soc.*, **1942**, 595.

2) S. H. Harper, ibid., **1942**, 587.

3) S. H. Harper, ibid., **1939**, 1099, 1424.

4) S. H. Harper, ibid., **1940**, 1178.

5) K. Fukui, M. Nakayama, M. Hatanaka, T. Okamoto and Y. Kawase, This Bulletin, **36**, 397 (1963).

synthesis of I from IV by the same procedure as described in the previous papers[6].

The formylation of IV by the hexamine method gave the 8-formyl compound V, which was converted into 5''-ethoxycarbonyl-furano-(2'', 3''; 7, 8)-2', 4', 5'-trimethoxyisoflavone (VI) by the action of ethyl bromomalonate and potassium carbonate. The alkaline hydrolysis of VI furnished the corresponding acid VII, which was decarboxylated in quinoline into I (m. p., 172~173°C) (reported m. p., 175°C[1]) in a good yield. To confirm the structure of I, the alkaline hydrolysis of I was carried out, giving II as colorless needles (m. p., 135~136°C) (reported m. p., 137°C[2]), which gave a brownish green ferric chloride test in ethanol.

Experimental*

8-Formyl-7-hydroxy-2', 4', 5'-trimethoxyisoflavone (V).—A mixture of IV (10 g.), hexamine (53 g.) and acetic acid (860 ml.) was heated on a steam bath for 8 hr. The hot solution obtained was treated with 1 : 1 hydrochloric acid (168 ml.) and again heated for 15 min.; then the solvent was removed in vacuo until ca. 200 ml. remained. After dilution with water (2000 ml.), the precipitates obtained were collected and crystallized from ethanol. The product was recrystallized from benzene to give V in the form of faintly yellow-colored needles (m. p., 190~191°C), which showed a red ferric chloride test in ethanol; yield, 6.3 g. (58%).

Found: C, 63.75; H, 4.58. Calcd. for $C_{19}H_{16}O_7$; C, 64.04; H, 4.53%.

5''-Ethoxycarbonyl-furano(2'', 3''; 7, 8)-2', 4', 5'-trimethoxyisoflavone (VI).—To a solution of V (6.3 g.) and ethyl bromomalonate in methyl ethyl ketone (500 ml.) potassium carbonate (21 g.) was added; the mixture was then refluxed for 10 hr. on a steam bath . The resulting mixture was filtered from precipitates, and the solvent was distilled off. The residual product was recrystallized from ethyl acetate to give VI in the form of colorless needles (m. p., 185~186°C) with a negative ferric chloride test in ethanol; yield, 5.2 g. (71%). IR: 1735 cm^{-1} (ester), 1650 cm^{-1} (γ-pyrone).

Found: C, 65.22; H, 4.82. Calcd. for $C_{23}H_{20}O_8$: C, 65.09; H, 4.75%.

5''-Carboxy-furano(2'', 3''; 7, 8)-2',4',5'-trimethoxyisoflavone (VII).—A mixture of VI (5.2 g.), acetone (600 ml.) and 10% aqueous potassium carbonate (175 ml.) was heated under reflux on a steam bath for 4 hr. After the acetone had been removed in vacuo, the residue was acidified with dilute hydrochloric acid. The resulting precipitate was recrystallized from ethanol to give VII in the form of colorless microcrystals (m. p., 282~283°C (decomp.)); yield, 2.7 g. (56%). IR: 1719 cm^{-1} (acid), 1648 cm^{-1} (γ-pyrone).

Found: C, 63.35; H, 4.36. Calcd. for $C_{21}H_{16}O_8$: C, 63.63; H, 4.07%.

Elliptol Isoflavone (I).—A mixture of VII (1.2 g.), copper powder (0.6 g.) and quinoline (30 ml.) was heated while being stirred in an atmosphere of nitrogen for 30 min. at 190~210°C until the evolution of carbon dioxide ceased. The solvent was then distilled off by steam distillation from the resulting mixture. The cooled mixture was filtered from precipitates and then extracted with ethyl acetate. After being washed successively with dilute hydrochloric acid, aqueous sodium bicabonate and then water, the solution was dried and evaporated. The residue was recystallized from methanol to give I in the form of colorless needles (m. p., 182~183°C) (reported m. p., 185°C[1]); yield, 0.8 g. (75%). IR: 1640 cm^{-1} (γ-pyrone).

Found: C, 68.28; H, 4.39. Calcd. for $C_{20}H_{16}O_6$: C, 68.18; H, 4.58%.

Elliptol Methyl Ether (II).—A mixture of I (0.3 g.), a 5% aqueous sodium hydroxide solution and ethanol (20 ml.) was refluxed for 3 hr. on a steam bath. After the solvent was evaporated, the residue was extracted with ethyl acetate. The resulting precipitate was recrystallized from methanol to give II in the form of colorless prisms (m. p., 135~136°C) (reported m. p., 137°C[2]), which showed a brownish green ferric chloride test in ethanol; yield, 0.2 g. (69%). IR: 1629 cm^{-1} (ketone).

Found: C, 66.70; H, 4.39. Calcd. for $C_{19}H_{18}O_6$: C, 66.66; H, 5.30%.

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[6] K. Fukui et al., ibid., 31, 688, 693 (1958); 33, 1240 (1960).

* All melting points are uncorrected; the infrared spectra were measured in Nujol.