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SYNTHESIS OF 2,4-DIACETYL-6-C-β-D-GLUCOPYRANOSYLPHLOROGLUCINOL

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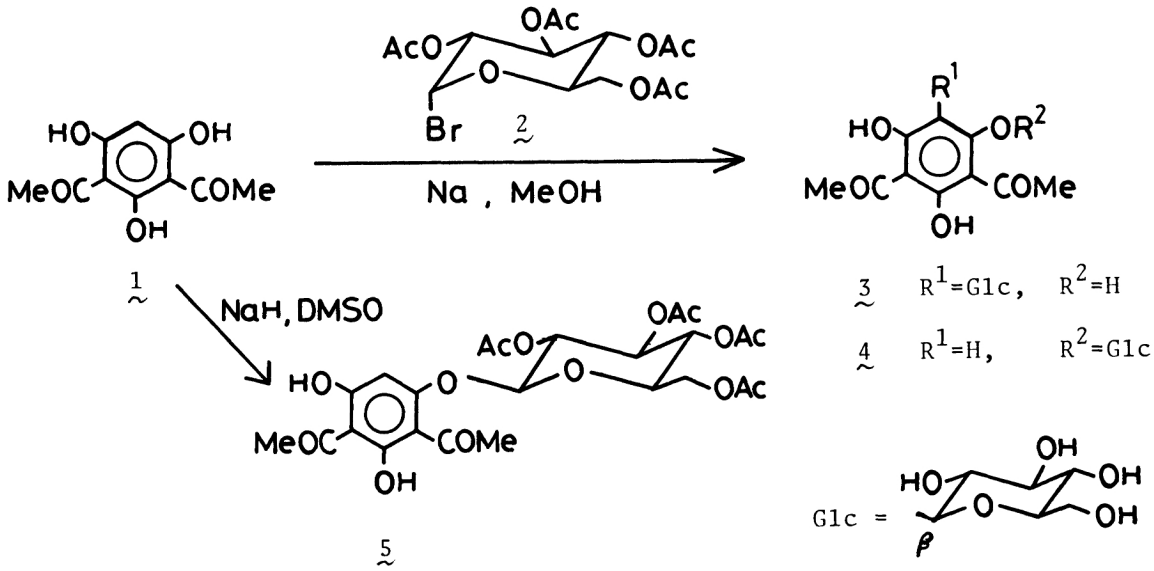
2,4-Diacetyl-6-C-β-D-glucopyranosylphloroglucinol was directly obtained by the glucosylation of 2,4-diacetylphloroglucinol with 2,3,4,6-tetra-O-acetyl-α-D-glucopyranosyl bromide in the presence of sodium in methanol.

Many C-glucosylflavonoids have recently been found in nature.[1] However, the synthetic method has not been established yet because of the difficulty of the C-glucosylation of their aglycons. In general, the yields of the C-glucosylflavonoids are extremely low.[2] Carthamin, the red coloring matter of the flowers of Safflower (Carthamus tinctorius L.), is one of the C-glucosides, which has a unique pseudoquinol skeleton.[3] In this communication, we wish to report a direct synthesis of 2,4-diacetyl-6-C-β-D-glucopyranosylphloroglucinol (3), an intermediate for the total synthesis of carthamin, by the glucosylation of 2,4-diacetylphloroglucinol (1)[4] with 2,3,4,6-tetra-O-acetyl-α-D-glucopyranosyl bromide (2). 2,4-Diacetyl-5-O-β-D-glucopyranosylphloroglucinol (4) was isolated as by-product.

Although the direct condensation of 1 with glucose was attempted by the recent report,[5] no desired compound 3 could be obtained.



To a stirring mixture of 2,4-diacetylphloroglucinol (1) (2.0 g) and metallic sodium (0.7 g) in dry methanol (20 ml) was slowly added 2 (5.0 g) under cooling with ice water. After standing overnight at 0-5 °C, the reaction mixture was slightly acidified with dilute hydrochloric acid and poured into 30 ml of water.

The resulting precipitate[6] was filtered and the filtrate was evaporated in vacuo. The residue was then chromatographed on silica gel (Wakogel C-200) using ethyl acetate-acetone-water-acetic acid (35:25:5:1) as an eluent to give a mixture of 3 and 4. Rechromatography of this mixture using ethyl acetate-methanol-water (18:1:1) as an eluent gave 3 (0.34 g, 9.4%) and 4 (0.23 g, 6.6%), respectively.

2,4-Diacetyl-6-C-β-D-glucopyranosylphloroglucinol (3); mp 155-156 °C, IR (KBr) 3400 (br) and 1620 cm^{-1}, ^{13}C-NMR (DMSO-d_6) δ 203.9 (s), 170.4 (s), 167.1 (s), 103.6 (s), 102.9 (s), 81.2 (d), 77.5 (d), 74.4 (d), 72.2 (d), 68.9 (d), 59.7 (t), and 32.6 (q). Heptaacetate: mp 108 °C, MS m/z 666 (M^+), IR (KBr) 1790, 1760, 1230, and 1180 cm^{-1}, ^{1}H-NMR ($CDCl_3$) δ 1.82, 2.02, 2.04, and 2.08 (each 3H, s, $OCOCH_3$×4), 2.24 and 2.35 (each 3H and 6H, s, $OCOCH_3$×3), 2.42 (6H, s, $COCH_3$×2), 4.73 (1H, d, J=10 Hz, 1'-H), 3.67-5.87 (6H, m).

2,4-Diacetyl-5-O-β-D-glucopyranosylphloroglucinol (4); mp 210 °C, IR (KBr) 3500, 1610, and 1070 cm^{-1}, ^{13}C-NMR (DMSO-d_6) δ 203.9 (s), 203.7 (s), 170.0 (s), 169.6 (s), 164.4 (s), 105.3 (s), 104.4 (s), 100.3 (d), 94.3 (s), 77.3 (d), 76.5 (d), 73.0 (d), 69.5 (d), 60.5 (t), 32.9 (q), and 32.7 (q).

The C-glucosyl structure of 3 was strongly supported by the above ^{13}C-NMR spectra[1] and the unusually high field shift of 2'-O-acetyl signal (δ =1.82 ppm)[7] in its heptaacetate. Further, the large coupling constant (10 Hz) of 1'-proton of the heptaacetate of 3 confirms the β-configuration of the glucosyl bond. The O-glucoside 4 was easily hydrolyzed by warming with 10% hydrochloric acid to give 1 and glucose, but, the C-glucoside 3 was unchanged under the same condition.

Compound 4 was also obtained by the deacetylation of 2,4-diacetyl-5-O-β-D-2',3',4',6'-tetra-O-acetylglucopyranosylphloroglucinol (5)[8] prepared by the glucosylation of 1 with 2 in the presence of sodium hydride in dimethyl sulfoxide at room temperature. In this reaction, no C-glucoside has been isolated.

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6) Recovered 1 (0.8 g).
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8) Compound 5; mp 174 °C (30% yield), IR (KBr) 1765, 1740, 1630, 1595, 1240, and 1215 cm^{-1}, ^{1}H-NMR ($CDCl_3$) δ 2.07 and 2.10 (each 6H, s, $OCOCH_3$×4), 2.56 and 2.73 (each 3H, s, $COCH_3$×2), 3.9-6.0 (7H, m), 7.44 (1H, s).

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