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SYNTHESIS OF NEOBAVAISOFLAVONE

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Condensation of 7-benzoyldaidzein (III) with 2-methyl-3-buten-2-ol gave 7-benzoyl-3'-(3-methyl-2-butenyl)daidzein (IV). Hydrolysis of IV with dilute alkali gave 3'-(3-methyl-2-butenyl)daidzein (neobavaisoflavone) (I), which was converted into isoneobavaisoflavone (VI) when heated with formic acid. 7-Benzyldaidzein (VII) was condensed with 2-methyl-3-buten-2-ol to give a chroman derivative (VIII), which was converted into VI by hydrogenolysis.

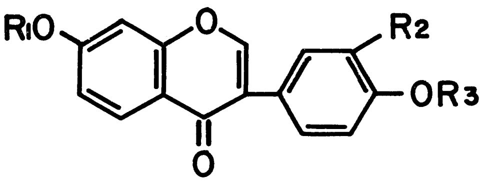
Neobavaisoflavone has recently been isolated from Psoralea corylifolia seeds (fruits).[1,2] Its structure has been shown to be 3'-(3-methyl-2-butenyl)daidzein (I) on the basis of the spectral and degradative evidences.[1,2] In this paper, we will report the synthesis of I from daidzein (II).

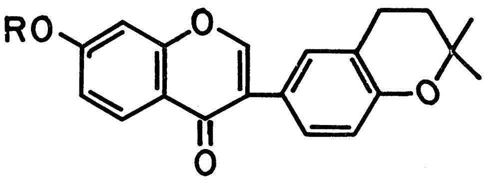
The partial benzoylation of daidzein (II) in pyridine gave 7-benzoyldaidzein (III) [mp 234-235°C; UV λ_{max}nm (log ε)(EtOH) 258(3.86), (EtOH + AcONa) 258(4.04)]. The condensation of III with 2-methyl-3-buten-2-ol in the presence of boron trifluoride etherate[3] gave 7-benzoyl-3'-(3-methyl-2-butenyl)daidzein (IV) (mp 152-153°C; M^+ 426). The NMR spectrum of IV showed the presence of one methylene group as a doublet centering at 3.36 ppm and one vinyl proton as a triplet centering at 5.34 ppm. IV was hydrolyzed with dilute alkali to yield the desired 3'-(3-methyl-2-butenyl)daidzein (neobavaisoflavone) (I) [mp 191-192°C; M^+ 322; IR ν_{max}^{KBr} 1625 cm^{-1}; NMR δ_{ppm}^{DMSO} 1.65s(6H)(CH_3 x 2), 3.20d(2H, J=7 Hz)(CH_2), 5.25t(1H, J=7 Hz)(CH=), 6.78d (1H, J=9 Hz)(5'-H), 6.84bs(1H)(8-H), 6.90q(1H, J=9,2 Hz)(6-H), 7.16q(1H, J=9,2 Hz) (6'-H), 7.21s(1H)(2'-H), 7.95d(1H, J=9 Hz)(5-H), 8.23s(1H)(2-H), 9.48s(1H)(4'-OH), 10.84s(1H)(7-OH); UV λ_{max}nm (log ε)(MeOH) 248(4.41), 258sh(4.37), 305sh(4.00), (MeOH + AcONa) 255(4.55), 331(4.11), (MeOH + NaOH) 255(4.52), 331(4.23); Found: C, 74.50; H, 5.70%, Calcd for $C_{20}H_{18}O_4$: C, 74.52; H, 5.63%] (lit.[1,2] mp 195-196°C). The acetylation of I by the acetic anhydride-pyridine method gave a diacetate (V) [mp 115-116°C; M^+ 406; NMR $\delta_{ppm}^{CDCl_3}$ 2.32s, 2.36s(each 3H)(CH_3CO x 2)]. I was also heated with formic acid to be cyclized into the corresponding chroman (isoneobavaisoflavone) (VI) [mp 243-244°C; M^+ 322; NMR $\delta_{ppm}^{CDCl_3}$ 1.78t, 2.76t(each 2H, J=7 Hz)(CH_2 x 2)].

The properties of this synthetic isoflavone (I) were consistent in full with those of natural neobavaisoflavone.

On the other hand, the partial benzylation of II in acetone-dimethylformamide gave 7-benzyldaidzein (VII) [mp 234.5-235.5°C; UV λ_{max}nm (log ε)(EtOH) 262(4.43), 306sh(4.00), (EtOH + AcONa) 262(4.44), 306sh(4.02)]. The condensation of VII with 2-methyl-3-buten-2-ol, in contrast with that of III, yielded a chroman derivative (VIII) alone [mp 152-153°C; NMR $\delta_{ppm}^{CDCl_3}$ 1.80t, 2.80t(each 2H, J=7 Hz)(CH_2 x 2)]. Hydrogenolysis of VIII with palladium charcoal in ethyl acetate-methanol gave the chroman (VI), which was identical with the isoneobavaisoflavone from I.

The condensation described above seems to be a method available for introduction of 3-methyl-2-butenyl group into the B ring of isoflavones.





I $R_1=R_3=H$, $R_2=(CH_3)_2C=CHCH_2$

II $R_1=R_2=R_3=H$

III $R_1=C_6H_5CO$, $R_2=R_3=H$

IV $R_1=C_6H_5CO$, $R_2=(CH_3)_2C=CHCH_2$, $R_3=H$

V $R_1=R_3=CH_3CO$, $R_2=(CH_3)_2C=CHCH_2$

VII $R_1=C_6H_5CH_2$, $R_2=R_3=H$

VI R=H

VIII $R=C_6H_5CH_2$

References

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