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Note

Facile Synthesis of 2,5-Disubstituted Furan Derivatives and Its Application for the Synthesis of Pyrethroid

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Some simple furan derivatives are easily supplied from biomass. For example, furfural is available from such materials as oat husks and maize cobs, which are rich in pentosans. Pentoses and hexoses are converted by acid treatment into furfural and 5-hydroxymethylfurfural, respectively.[1] The chemistry of furan, thus, is important to advance chemical uses of such renewable resource of carbohydrate. In addition, a number of naturally occurring furan derivatives which exhibit various biological activities are known.[2] Some synthetic pyrethroid which are esters of chrysanthemic acid with 5-substituted furfuryl alcohols are known to have strong biological activities.[3] We report here alkylation of 5-methyl-2-furancarboxylic acid (**1**) and furfuryl alcohol (**6**) and its application for one pot synthesis of pyrethroid which has 5-substituted furfuryl group.

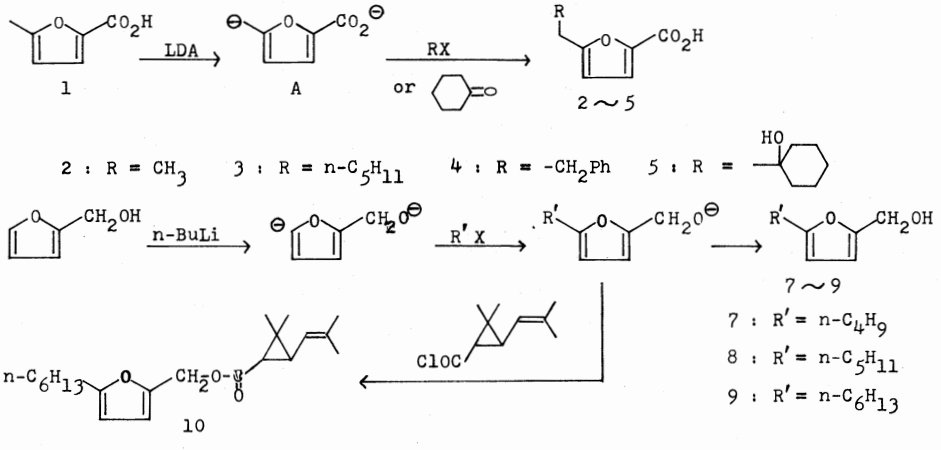
Previously we reported alkylation of 2,4-dimethyl-3-furancarboxylic acid and its application for synthesis of sesquiterpenes.[4] By the similar treatment, 5-methyl-2-furancarboxylic acid (**1**) was alkylated selectively. To a solution of 5 m mol of lithium diisopropylamide in THF-hexane, 2 m mol of the acid **1** in THF was added at −78°C to afford a yellow solution of dianion **A**. The dianion **A** was treated with electrophilic reagents (methyl iodide, *n*-pentyl bromide, benzyl chloride and cyclohexanone) to produce the corresponding 5-alkyl-2-furancarboxylic acids (**2**, **3**, **4** and **5**), selectively in yields of 57～97%.* None of ester was obtained under the condition.

In order to synthesize the furan derivatives which has other functional group, alkylation of furfuryl alcohol (**6**) was investigated. Dianion **B** generated from alcohol (**6**) by *n*-butyl lithium was treated with alkyl halides (*n*-butyl bromide, *n*-pentyl bromide and *n*-hexyl bromide) to give the corresponding 5-alkylfurfuryl alcohols (**7**, **8** and **9**), respectively. No ether was obtained.

One pot synthesis of pyrethroid which have 5-alkylfurfuryl group was then investigated using the alkylation reaction of furfuryl alcohol. Alcohol **6** was alkylated with *n*-hexyl bromide as previously described. The reaction mixture was treated with *trans*-chrysanthemic chloride in benzene for 15 hr at ambient temperature to give 5-*n*-hexylfurfuryl *trans*-chrysanthemate (**10**) in 84% yield. This one pot synthesis should be useful for the study of new posticides and metabolism of pyrethroid.

EXPERIMENTAL

*Alkylation of 5-methyl-2-furancarboxylic acid (**1**).* THF solution of acid (**1**) (252.2 mg: 2.0 m mol) which was



* The acids **4** and **5** were methylated with diazomethane to give esters (**4'**) and (**5'**) before purification.

prepared by oxidation of 5-methylfurfuryl alcohol with nickel peroxide in 5% NaOH was added at −78°C to a solution of lithium diisopropylamide (5 m mol) in THF (10 ml)-hexane (~2.5 ml) under argon atm. After being stirred for 20 min at −78°C, the mixture was warmed to 0°C and 2.4 m mol of electrophilic reagent (methyl iodide, *n*-pentyl bromide, benzyl bromide or cyclohexanone) was added. The reaction was quenched after 1 hr by addition of ice water. The neutral compounds were removed by extraction with ether. The organic layer was extracted with 5% NaOH. The organic layer was found to contain none of ester of 5-alkyl-2-furancarboxylic acid. The combined aqueous layer was acidified with conc. HCl and extracted with ether. The organic layer was washed with brine, dried and evaporated to give crude acid (**2**, **3**, **4** or **5**). The acids (**2** and **3**) were purified on silica gel using hexane–ether (1 : 1) and recrystallized from ether-hexane. The acids (**4** and **5**) were converted to the esters (**4′** and **5′**) with diazomethane in ether and purified by column chromatography (silica gel, hexane–ether). **2** (yield: 97%), mp 90.5°C; IR (Nujol) ~3000, 1670, 1515, 1290, 1212 and 1153 cm^{-1}; NMR ($CDCl_3$) δ 7.14 (1H, d, J=4 Hz), 6.07 (1H, d, J=4 Hz), 2.72 (2H, q, J=8 Hz) and 1.23 (3H, t, J=8 Hz). **3** (90%), mp 67.5°C; IR (Nujol) ~3000, 1680, 1510, 1300, 1207 and 1152 cm^{-1}; NMR ($CDCl_3$) δ 7.24 (1H, d, J=4 Hz), 6.16 (1H, d, J=4 Hz) and 2.70 (2H, t, J=8 Hz). **4′** (57%), an oil; IR (neat) 1715, 1515, 1302, 1202 and 1125 cm^{-1}; NMR ($CDCl_3$) δ 7.20 (5H, s), 7.05 (1H, d, J=4 Hz), 6.05 (1H, d, J=4 Hz), 3.88 (3H, s) and 3.00 (4H, s); MS m/z 230 (M^+) and 139 (base peak). **5′** (83%), an oil; IR (neat) 3408, 1712, 1516, 1313, 1206 and 1138 cm^{-1}; NMR ($CDCl_3$) δ 7.06 (1H, d, J=4 Hz), 6.22 (1H, d, J=4 Hz), 3.83 (3H, s) and 2.80 (2H, s); MS m/z 238 (M^+) and 140 (base peak).

*Alkylation of furfuryl alcohol (**6**).* Alcohol **6** (980 mg: 10 m mol) was added to a solution of *n*-butyl lithium (24 m mol) in THF (20 ml)–hexane (~13 ml) at 0°C under argon atm. After being stirred for 2 hr at 0°C, 3.02 g (20 m mol) of *n*-pentyl bromide was added to the mixture. The mixture was stirred for 15 hr at 0~10°C. The mixture was poured into brine and extracted with ether. The organic layer was dried and evaporated. The product was purified on silica gel (ether–hexane, 1 : 1) to give 5-*n*-pentylfurfuryl alcohol (**8**). By the similar treatment, furfuryl alcohol **6** was alkylated with *n*-butyl bromide and *n*-hexyl bromide to afford the corresponding 5-alkylfurfuryl alcohol, respectively. The products were isolated only for analysis by column chromatography (silica gel; hexane–ether, 1 : 1), because of their volatility. **7** an oil; IR (neat) 3350, 1560 and 1005 cm^{-1}; NMR ($CDCl_3$) δ 6.08 (1H, d, J=4 Hz), 5.88 (1H, d, J=4 Hz), 4.40 (2H, s) and 2.60 (2H, t, J=8 Hz). **8** an oil; IR (neat) 3320, 1560 and 1005 cm^{-1}; NMR ($CDCl_3$) δ 6.14 (1H, d, J=4 Hz), 5.88 (1H, d, J=4 Hz), 4.50 (2H, s) and 2.57 (2H, t, J=8 Hz); MS m/z 168 (M^+) and 111 base peak). **9** an oil; IR (neat) 3320, 1560 and 1005 cm^{-1}; NMR ($CDCl_3$) δ 6.13 (1H, d, J=4 Hz), 5.88 (1H, d, J=4 Hz), 4.49 (2H, s) and 2.56 (2H, t, J=8 Hz); MS m/z 182 (M^+) and 111 (base peak).

*5-n-Hexylfurfuryl trans-chrysanthemate (**10**).* A solution of the dianion **B** prepared from 6 m mol of the alcohol **6** was treated with *n*-hexyl bromide as described previously. In another flask, 6 m mol of *trans*-chrysanthemic acid and 0.5 ml of thionyl chloride in 5 ml of benzene was heated under reflux for 1 hr. The excess of thionyl chloride was evaporated *in vacuo*. The acid chloride in benzene was added to the mixture of alkylation reaction. The mixture was stirred for 15 hr at room temperature, poured into brine and extracted with ether. The organic layer was washed with 10% sodium carbonate, dried and evaporated. Chromatographic purification (silica gel; hexane–ether, 30 : 1) of the residue gave 1.67 g (84%) of 5-*n*-hexylfurfuryl *trans*-chrysanthemate (**10**) as an oil; IR (neat) 1720, 1560 and 1145 cm^{-1}; NMR ($CDCl_3$) δ 6.30 (1H, d, J=4 Hz), 5.96 (1H, d, J=4 Hz), 4.98 (2H, s), 2.60 (2H, t, J=8 Hz), 1.66 (6H, s), 1.23 (3H, s) and 1.08 (3H, s); MS m/z 332 (M^+) and 165 (base peak); UV λ_{max}^{EtOH} nm (ε) 221 (16580).

REFERENCES

1) M. S. Feather, D. W. Harris and S. B. Nichols, *J. Org. Chem.*, **37**, 1606 (1972).
2) *e.g.*, L. J. Morris, M. O. Marshall and W. Kelly, *Tetrahedron Lett.*, **1966**, 4249; C. H. Faweet, D. M. Spencer, R. L. Wain, E. R. H. Jones, M. LeQuan, C. B. Pase and V. Thaller, *Chem. Commun.*, **1965**, 422.
3) Y. Katsuda, T. Chikamoto, H. Ogami, H. Hirobe and T. Kunishige, *Agric. Biol. Chem.*, **33**, 1361 (1969).
4) M. Tada, Y. Sugimoto and T. Takahashi, *Bull. Chem. Soc. Jpn.*, **53**, 2966 (1980).

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