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A NEW ROUTE TO TROPANES[1]

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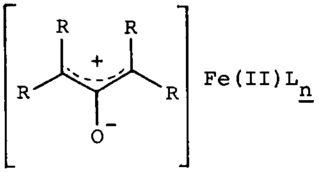
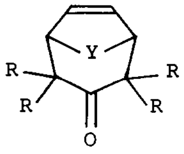
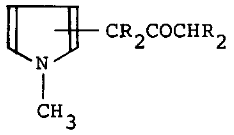
The oxyallyl intermediates of type I (L = Br, CO, solvent, etc.) generated from α,α'-dibromo ketones and iron carbonyls[2] can be trapped efficiently by 1,3-dienes;[3] the reaction with cyclopentadiene[3] or furan[4] affords the cyclocoupling products II and III, respectively, in high yields. N-Methylpyrrole as a five-membered receptor, however, does not give the expected cycloadduct IV, but affords the electrophilic substitution products V and VI. This paper describes that utilization of pyrroles bearing an electron-withdrawing group at the nitrogen atom leads to the desired cycloadducts, thereby opening a new, simple route to tropane alkaloids.[5]



I



II, Y = CH_2
III, Y = O
IV, Y = NCH_3

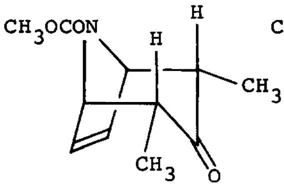


V, α isomer
VI, β isomer

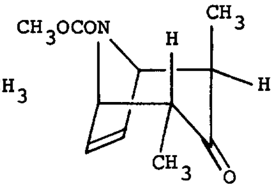
A typical experiment was performed as follows. A mixture of 2,4-dibromopentan-3-one (20 mmol), N-carbomethoxypyrrole (20 mmol), and $Fe_2(CO)_9$ (27.5 mmol) in benzene (80 ml) was stirred under nitrogen at 25° with irradiation using light of wavelength longer than 350 nm (aq $CuSO_4$ as a filter). After 10 hr, the reaction mixture was quenched by addition of saturated $NaHCO_3$ solution (200 ml) and extracted with ethyl acetate (four times with 50-ml portions). The combined organic layers were dried and concentrated *in vacuo*. The resulting residue was dissolved in ether—benzene (1:3) and passed through a short alumina column to give a mixture of three cycloadducts VII—IX (3:2:2 ratio by nmr analysis) in 60% combined yield. Separation of the isomers was effected by careful chromatography on a silica gel column (200 g) using ethyl acetate—*n*-hexane (1:5) as eluent. All these adducts in CCl_4 solution showed intense ir bands in a 1710—1700-cm^{-1} region due to the $NCOOCH_3$ and CO functions. The nmr spectra (CCl_4) of the cis isomers VII, mp 60—61°, and IX, mp 63—64°, exhibited a six-proton doublet (*J* = 7 Hz) at δ 1.00 and 1.25, respectively, arising from the two equivalent methyl groups, whereas the spectrum of the oily trans isomer VIII having non-equivalent methyls showed two three-proton doublets at δ 1.01 and 1.23 (*J* = 7 Hz).

Similarly the reaction of 2,4-dibromo-2,4-dimethylpentan-3-one and *N*-acetylpyrrole with the aid of $Fe_2(CO)_9$ (40°, 18 hr, without light) gave the bicyclic adduct X in 70% yield. Ir (CCl_4) 1720 (CO) and 1660 cm^{-1} ($NCOCH_3$).

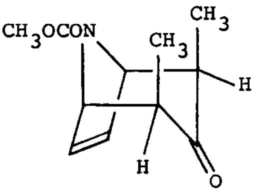
The cyclic adducts VII—X thus obtained could be converted readily to various tropane derivatives employing ordinary synthetic procedures.[5]



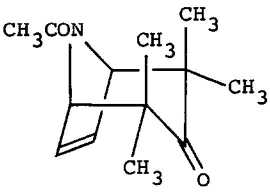
VII



VIII



IX



X

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