Tetrahedron Letters No. 8, pp 709 - 710.	0040-4039/79/0215-0709$02.00/0
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AN UNUSUAL ARENE SIDE-CHAIN CHLORINATION WITH VANADIUM OXYTRICHLORIDE

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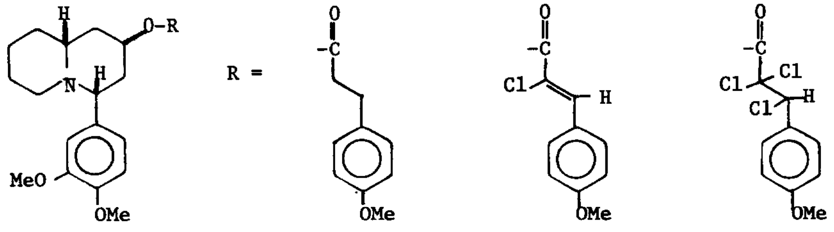
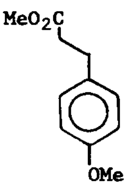
Vanadium oxytrichloride ($VOCl_3$) has been utilized as a reagent for the intramolecular oxidative coupling of phenols.[1] In some cases it also functions as an aryl chlorinating,[1,2] or even a dealkylating-chlorinating,[3] agent. We have now found that $VOCl_3$ can also be an arene side-chain chlorinating agent.

During an attempt at the intramolecular coupling of the ester 1[4] [$VOCl_3$, CH_2Cl_2, CF_3CO_2H-$(CF_3CO)_2O$, -78°→RT, then 3 hr reflux] a new compound, 2,[4] was obtained in 70% yield. The structure of 2 was assigned from the NMR and mass spectra. In the mass spectrum the parent ion (m/e 485) isotope pattern indicated the presence of one chlorine. In addition, the quinolizidinol nucleus fragment ion (m/e 273) was the same as in 1 indicating that the chlorine was in the acid portion of the ester. In the NMR spectrum the principal changes from 1 were the disappearance of the multiplet at δ 2.4-3.0 [$-C(O)CH_2CH_2Ar$], the downfield shift of a two-proton aromatic doublet (δ 7.84) and the appearance of a one proton singlet at δ 7.87. This latter signal was assigned to the β-proton of the α-chlorocinnamate. Repetition of this oxidation with refluxing for 16 hr afforded 2 (27%) and another product, 3[4] (33%). The mass spectrum of 3 indicated the presence of three chlorines (m/e 555) in the acid portion. The NMR spectrum was similar to 2 except that the downfield singlet was at δ 5.67. The benzylic position for the proton in 3 was assigned by analogy to 2 and the presence of an ion (m/e 155) corresponding to $CH_3OC_6H_4CHCl$ in the mass spectrum.

We investigated this unusual oxidative-chlorination further by treatment of the ester 4 with $VOCl_3$ under similar conditions (3 hr reflux). In this case a 14%



1	2	3



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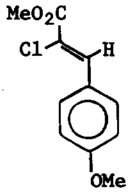

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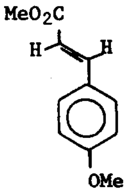

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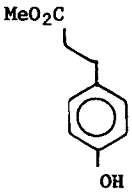

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yield of 5[4] and a 21% yield of 6[5] were obtained along with a 37% recovery of 4. The structure of 5 was assigned from its spectra, as with 2. The spectra, melting point, and tlc behavior of 6 were compared with an authentic sample. Thus, the simple methoxy ester, 4, reacts in the same manner as 1, but it is apparently not as reactive. An example of the difference in the reactivity of phenols and aryl ethers towards $VOCl_3$ is the observation that the phenolic ester, 7, was recovered from the above conditions unchanged.

It is enticing to consider 3 to be the product of chlorine addition to 2 and 5 to be the result of chlorine addition to 6 followed by dehydrohalogenation. In fact, treatment of 6 with $VOCl_3$ results in a significant conversion to 5. Thus, $VOCl_3$ may be functioning as a "Cl_2" source in this case. Further efforts are being made to understand these reactions and to use them synthetically. In the meantime, however, side chain as well as aryl chlorinations must be recognized as possible side reactions during $VOCl_3$ oxidations.

Acknowledgements

The authors wish to thank Dr. Catherine Costello for obtaining the high resolution mass spectra and the PHS for financial support (Research Grant NS 12007).

References and Notes

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(Received in USA 14 November 1978)