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# THE REACTIONS OF PHENOLIC REAGENTS WITH α-BROMO MICHAEL ACCEPTORS IN THE $K_2CO_3$-ACETONE SYSTEM. A STEREOSPECIFIC $Ad_{SN}E$ PROCESS.

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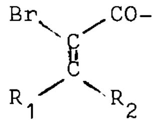
Summary: α-bromo Michael acceptors undergo ipso-substitution by phenol or benzenethiol in the $K_2CO_3$-acetone system, the reaction originating the (Z) isomers, via a stereospecific $Ad_{SN}E$ process.

The mechanism of the reactions of vinyl halides bearing an activating group on the adjacent $sp^2$-carbon have been more extensively studied$^{(1)}$ than the mechanism, and particularly the stereochemistry, of the reactions of ethylenic systems bearing these substituents on the same carbon. We now wish to report the reactions of phenol and benzenethiol with α-bromo Michael acceptors 1a-e leading to stereospecific formal ipso-substitution of the bromine.



1a: $R=OC_2H_5$; $R_1=R_2=H$
1b: $R=OC_2H_5$; $R_1=H$; $R_2=CH_3$
1c: $R=OC_2H_5$; $R_1=CH_3$; $R_2=H$
1d: $R=CH_3$; $R_1=H$; $R_2=CH_3$
1e: $R=CH_3$; $R_1=CH_3$; $R_2=H$

The reactions were performed by treating the substrate with the above phenolic reagents in boiling anhydrous acetone in the presence of $K_2$ $CO_3$, checking the structure of the transient intermediates and products by GLC, GMS and NMR analyses. By reacting phenol with 1a until full conversion (6 h) a mixture of about 40% of adduct 2 and 50% and 10% respectively of the products of ipso- 3 and cine -substitution 4 were obtained, the latter having the (E)-configuration.

$C_6H_5$-O-$CH_2$-CHBr-COOEt 2

$CH_2$=C($OC_6H_5$)-COOEt 3

$C_6H_5$-O-CH=CH-COOEt 4

The reaction of 1a with benzenethiol was in turn completed within 20', affording 10% each of 5 and 6, and 80% of 7, 6 being the only product after 2.5 h.

$C_6H_5$-S-$CH_2$-CHBr-COOEt 5

$CH_2$=C($SC_6H_5$)-COOEt 6

$C_6H_5$-S-$CH_2$-CH($SC_6H_5$)-COOEt 7

With prochiralic esters 1b and 1c, the reactions proceeded much faster with the (E)- than with the (Z)-isomer, leading exclusively to 8 and 9 respectively; considerable amounts of 10 were isolated early in the reaction of 1c with benzenethiol.

$CH_3-CH=C(OC_6H_5)-COOEt$ 8 (Z)    $CH_3-CH=C(SC_6H_5)-COOEt$ 9 (Z)    $CH_3-CH(SC_6H_5)-CH(SC_6H_5)-COOEt$ 10

The reactions of the two phenols with a mixture (roughly 1:1) of ketones 1d,e, as well as with the pure (Z)-isomer 1d, were shown to be faster than those of the corresponding esters 1b,c, the only final products being 11 and 12 respectively; the formation of 13 was detected early in the reaction of 1e with benzenethiol.

$CH_3-CH=C(OC_6H_5)-COCH_3$ 11 (Z)    $CH_3-CH=C(SC_6H_5)-COCH_3$ 12 (Z)    $CH_3-CH(SC_6H_5)-CH(SC_6H_5)-COCH_3$ 13

Fast isomerization of 1d into 1e was observed when a mixture of the two ketones was heated in the $K_2CO_3$-acetone system, while no isomerization occurred with esters 1b and 1c.

The formation of vinyl thioethers 9 and 12 with the (Z)-configuration is not the result of a non-stereospecific course of the reaction, followed by post-isomerization, since the conversion of the (E)-isomers into the thermodynamically more stable (Z)-isomers has been shown to be a rather slow process. The intermediate formation of adducts 2, 5 and diphenylthio derivatives 7, 10, 13 indicate that the above reactions proceed through the $Ad_{SN}E$ mechanism. The difference in reactivity of the substrates under investigation can be explained in terms of the electron attracting power of the activating groups, as well as by the different ability of the two phenols to function as good leaving groups. Moreover, S-3 neighbouring group participation might assist substitution of the bromine on the newly generated $sp^3$-carbon atom of the adduct, thus accounting for the much faster reactions of all the substrates with benzenethiol.

## References

1) A.F. Cockerill and R.G. Harrison, The chemistry of functional groups. Supplement A, Part 1, ed. S. Patai, Interscience, London, 1977, ch. 4, pag. 221, and references there quoted.

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