Electronic Substituent Effects of Furoxan and Furazan Systems

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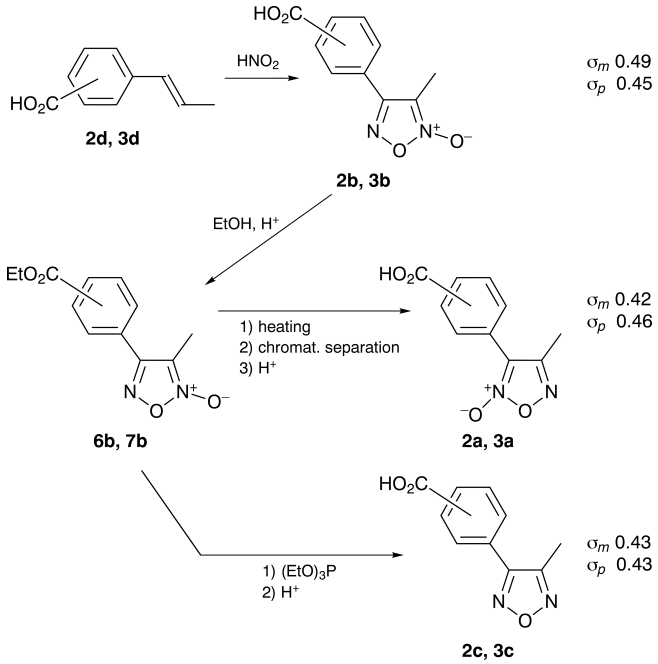
Heterocyclic systems 3-furoxanyl, 4-furoxanyl and 3-furazanyl have been characterised as substituents by their substituent constants σ_m, σ_p, σ_I and σ_R, determined from pK and ^{19}F NMR shifts: they are strongly electron attracting but weakly conjugated.

Furoxans are important in biochemistry as NO donors under physiologic conditions.[4] Parallel with their pharmacochemistry, we have also investigated their physical properties: lipophilicity,[6] dipole moments and electron distribution.[7] They may be described as electron overcrowded molecules. Here we report the Hammett substituent constants σ_m and σ_p of 4-methyl-3-furoxanyl (**1a**), 3-methyl-4-furoxanyl (**1b**) and also of the parent heterocycle without oxygen, 4-methyl-3-furazanyl (**1c**). We used the standard approach[11] based on pK values of substituted benzoic acids **2a**–**c** and **3a**–**c** in 50% ethanol. The methyl group on the heterocycle was necessary for the stability of compounds and scarcely influences the σ values.



All the heterocyclic systems are rather strongly electron attracting by the inductive mechanism, as strong as *e.g.* halogens, but seem to be only very slightly conjugated as weak donors. We also determined the inductive constants σ_I and resonance constants σ_R by a method[20] exploiting the ^{19}F NMR shifts of substituted fluorobenzenes. This approach confirmed the inductive electron attracting character of these groups but suggested their conjugation as weak acceptors. Evidently, they can be weakly conjugated in either sense in different molecules.

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Techniques used: Potentiometry, NMR (^{1}H, ^{13}C, ^{19}F), microanalysis

Table 1: pK values of substituted benzoic acids (50% ethanol) and the derived σ values

Table 2: ^{19}F NMR data of fluoro derivatives and the derived σ values

Fig. 1: Mesomeric formulas for the substituents **1a**, **1b**, **1c**

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