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## Thin-layer chromatography of some substituted esters and diamides of malonic acid on silica gel

In the synthesis of some pharmaceuticals in which malonic acid esters were used as intermediates, it was necessary to conduct some purity control tests. Though substituted malonic acid esters have mostly been studied by GC[1,2], not much TLC[3] work seems to have been published. Therefore it was interesting to know the TLC behaviour of mono- and disubstituted esters and also diamides of malonic acid.

The substituted malonic acid esters were prepared by alkylation. Diamides could be synthesized through aminolysis of the corresponding esters. The nonreactive ethylbutylmalonic acid ester was converted via the Na derivative of *m*-phenylenediamine to the di(*m*-amino)anilide of ethylbutylmalonic acid according to the process of STERN[4].

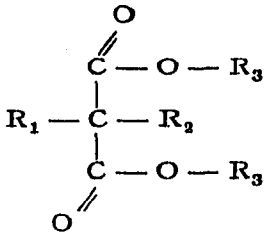
*Experimental*

*Materials.* 10 μg of each substance were applied on a thin-layer plate pre-coated by Woelm with Silica Gel F 254/366. After equilibration ascending chromatography was carried out at 20° in standard glass tanks. The solvent systems used were: (I) cyclo-hexane–ether–toluene (3:2:1); (II) benzene–ethyl acetate–ether (8:3:2); (III) benzene–methanol (5:1).

*Visualization.* The thin-layer plates were viewed under UV light at 254 mμ. Not all substances quenched the fluorescence. Only diamides could be identified by this method. For this purpose the plate was put in an iodine chamber before examining it

TABLE I

COLOURS AND $R_F$ VALUES OF MALONIC ACID ESTERS



| $R_1$ | $R_2$ | $R_3$ | $R_F$ value in solvent system I | Colour of the spots |
|---|---|---|---|---|
| $-C_4H_9$ | $-H$ | $-C_2H_5$ | 0.53 | deep violet |
| $-C_2H_5$ | $-C_2H_5$ | $-C_2H_5$ | 0.54 | yellowish |
| $-C_2H_5$ | $-H$ | $-C_2H_5$ | 0.47 | deep violet |
| $-C_2H_5$ | $-C_4H_9$ | $-C_2H_5$ | 0.57 | yellowish |
| $-C_2H_5$ | $-C_2H_5$ | $-CH_3$ | 0.44 | yellowish |
| $-C_3H_7$ | $-H$ | $-C_2H_5$ | 0.46 | deep violet |
| $-CH_3$ | $-H$ | $-C_2H_5$ | 0.30 | deep violet |
| $-CH_2-CH=CH_2$ | $-CH_2-CH=CH_2$ | $-C_2H_5$ | 0.48 | yellowish |
| $-Br$ | $-C_4H_9$ | $-C_2H_5$ | 0.49 | yellowish |
| $-H$ | $-H$ | $-C_2H_5$ | 0.26 | deep violet |

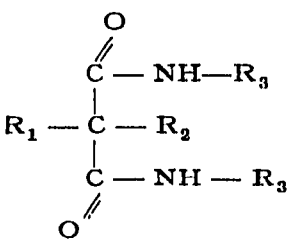
under UV light. For the mono- and disubstituted esters of malonic acid, a solution of Bromocresol Green/Bromophenol Blue and potassium permanganate[5] was tested as a spraying reagent. In this case, the spots were neither so defined nor was the colour so stable. Moreover, this spraying reagent was not sensitive enough. A better method of visualization was applied. The thin-layer plate was placed in an iodine tank for 1–2 min and then immediately sprayed with Bromocresol Purple[6]. The spots could be seen in normal light.

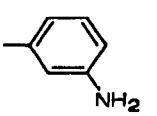
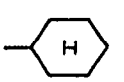
*Results*

With Bromocresol Purple, monosubstituted esters gave blue whereas the disubstituted esters showed yellowish blue spots. On the basis of these colours, one can differentiate between the mono- and disubstituted malonic acid esters. The results have been recorded in Tables I and II.

TABLE II

$R_F$ VALUES OF MALONIC ACID DIAMIDES



| $R_1$ | $R_2$ | $R_3$ | *Solvent system* | $R_F$ *value* |
|---|---|---|---|---|
| H | $-C_4H_9$ | $-C_6H_5$ | II | 0.15 |
| H | $-C_2H_5$ | $-C_6H_5$ | II | 0.45 |
| $-C_2H_5$ | $-C_4H_9$ |  | II | 0.61 |
| $-C_4H_9$ | $-H$ |  | III | 0.60 |

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