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SYNTHESIS OF THE CLAVINE SKELETONS BY PHOTOCYCLISATION OF N-METHACRYLNAPHTHALIDES

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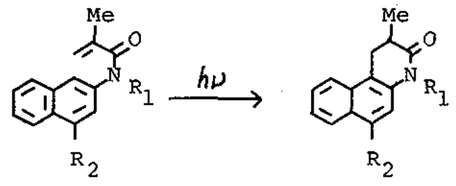
Photocyclisation of N-methacrylnaphthalides (Ia-d, and VIII), prepared from various 2-naphthylamines and 4-aminonaphthostyril, afforded the benzo[f]quinolones (IIa-d) and indolo[4,3-f,g]quinoline-5,8-dione (IX), providing a route for the preparation of the clavine alkaloids.

Unsaturated acylanilides are known to undergo facile photocyclisation to afford the quinoline skeletons.[1,2] This reaction is particularly useful for the preparation of quinolines and phenanthridines.[3] As an extension of this photocyclisation, we now report facile photocyclisation of N-methacrylnaphthalides which would offer an useful route for the preparation of the skeleton of the clavine alkaloids.

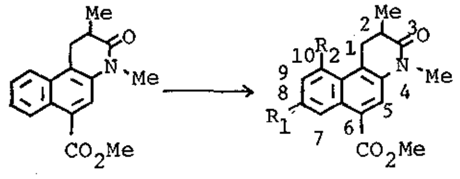
N-Methacrylnaphthalides (Ia-d), which were prepared from various 2-naphthylamines[4] and methacryloyl chloride, were readily photocyclised in a benzene solution by irradiation of a low pressure mercury lamp at room temperature to afford the corresponding benzo[f]quinolones (IIa-d) in good yields as summarised in the scheme. Since examples of introduction of a nitro group into the peri position (7) to a carboxyl group were known[5], we attempted nitration of the photocyclised product (IId). However, the nitro group was introduced not into the desired position but 8- and 10-positions (IIIa,b,c). Therefore, in order to prepare the compound having the skeletal structure of clavines, the mono-nitro derivative (IIIa) was employed for further transformation, that is, reduction with Raney-nickel and hydrazine converted (IIIa) into the 10-aminobenzo[f]quinolone (IV) which was then acetylated. Nitration of the acetamido derivative (V) afforded the mono-nitro product (VI) which was then transformed by reduction with Raney-nickel and hydrazine into the corresponding indolo[4,3-f,g]quinoline-5,8-dione (VII), m.p. $>300°$, which exhibited i.r. absorptions at 3300-3100 (NH×2) and 1690-1640 (NCO×3) and n.m.r. peaks[+] at δ 7.87 (1H, s, 6-H), 7.25 and 6.91 (2H, each d, J 7Hz, 2- and 3-H), 3.43 (3H, s, NMe), 2.10 (3H, s, COMe), and 1.18 (3H, d, J 6.5Hz, CMe), thus proving the position of a nitro group as shown.

However, the above result, which seemed not so useful as a preparative method for the clavine structures though its basic skeleton was prepared, pushed us to investigate photocyclisation of N-methacrylamide (VIII), which was prepared by acylation of 4-aminonaphthostyril[5] with methacryloyl chloride in good yield.



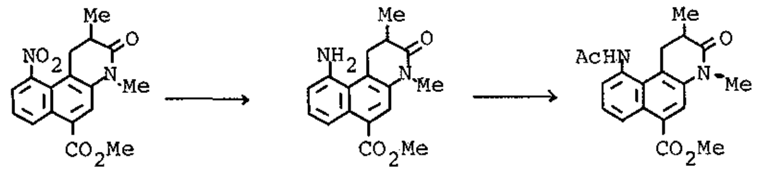
(Ia,b,c,d) (IIa,b,c,d)

(II)	R_1	R_2	Irradiation Time (hr)	Yield (%)
a	H	H	46	59
b	Me	H	17	50
c	H	CO_2Me	96	42.5
d	Me	CO_2Me	26	48

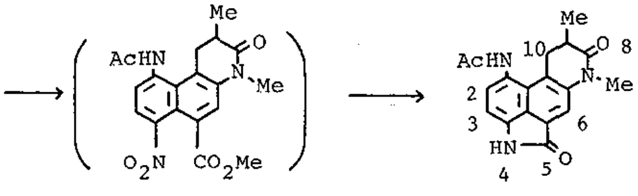


(IId) (IIIa,b,c)

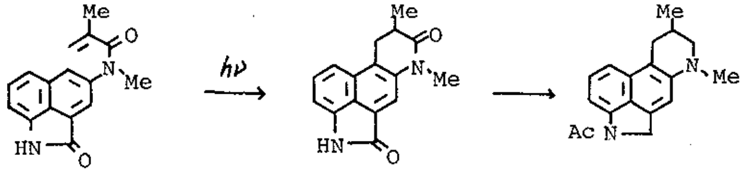
(III)	R_1	R_2	Nitration 90% HNO_3	Yield (%) 60% HNO_3	70% NHO_3-Ac_2O
a	H	NO_2	—	27	56
b	NO_2	H	—	35	17
c	NO_2	NO_2	30	—	—



(IIIa) (IV) (V)



(VI) (VII)



(VIII) (IX) (X)

Irradiation of the naphthalide (VIII) in a benzene solution in the presence of acetic acid (15:1) over 96 hrs. afforded the corresponding photocyclised product (IX) in 42 % yield, which exhibited i.r. absorptions at 3400 (NH), 1710 (NCO), and 1655 (NCO) and n.m.r. peaks at δ 10.63 (1H, br s, NH), 7.82 (1H, s, 6-H), 7.63 (1H, d-d, J 9 and 2Hzs, 3-H), 7.50 (1H, d-d, J 9 and 6Hzs, 2-H), 6.90 (1H, d-d, J 6 and 2Hzs, 1-H), 3.45 (3H, s, NMe), and 1.25 (3H, d, J 7Hz, CMe). Lithium aluminium hydride reduction of (IX) followed by acetylation afforded the compound (X) in good yield, which has the structure of clavines.

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+ N.m.r. spectra were measured in DMSO-d_6 solution.

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