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Note

Steroids and related studies

XL. Thin-layer chromatography of some steroidal ketones, oximes and lactams

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We reported earlier TLC data for some lactam, tetrazole and basic and quaternary azasteroids[1]. Our continuing programme on azasteroids has yielded a variety of new compounds and in this paper we give mainly the results of TLC studies on several steroidal oximes and lactams; data on some steroidal ketones, including those used as starting materials, are also given.

EXPERIMENTAL

Steroid derivatives

The ketones (Table I), oximes (Table II) and lactams (Tables III and IV) were mostly prepared in our laboratory. Literature references to methods of preparation of the compounds are given in the tables.

Adsorbent and TLC plates

Silica gel G (Merck, Darmstadt, G.F.R.), was mixed with distilled water (30 g of gel per 60 ml of water), and coated on 20 × 20 cm plates with a layer thickness of 0.25 mm. The plates were air dried for 15 min, heated at 110° for 60 min, then stored in a drying cabinet over calcium chloride.

The running distance was 16 cm at a temperature of 22–25°, and the load of steroid derivative applied was 50–100 μg.

Detection

Cerium(IV) sulphate solution [2 g in 100 ml of 10% (v/v) sulphuric acid] was used as the spray reagent, followed by heating at 150° for 30 min, which produced permanent black spots. Exposure to iodine vapour was also used, and produced brown spots in only 2–4 min.

Solvents

All the solvents used were of analytical grade and were used without further treatment. The following solvent systems were used: (1) chloroform–methanol (99:1);

(2) benzene–ethyl acetate (17:3); (3) benzene–methanol (19:1); (4) chloroform–ethyl acetate (9:1); (5) chloroform–methanol (39:1); (6) chloroform–ethyl acetate (8:2); (7) chloroform–methanol (24:1); (8) benzene–methanol–ethyl acetate (16:3:1); (9) ethyl acetate–benzene (9:1); (10) benzene–methanol (17:3); (11) chloroform–ethyl acetate–methanol (12:7:1); (12) chloroform–methanol (9:1); (13) benzene–methanol (3:1); and (14) chloroform–ethyl acetate–methanol (10:7:3).

RESULTS

Table I lists the R_F values of some steroidal ketones, including those which were used as starting materials, Table II of steroidal ketoximes and Tables III and IV of steroid lactams.

TABLE I

THIN-LAYER CHROMATOGRAPHY OF STEROIDAL KETONES IN SOLVENT SYSTEMS 1, 2, 3 AND 4

Compound	*R_F value*			
	1	*2*	*3*	*4*
Cholest-4-ene-3,6-dione[2]	0.66	0.62	0.70	0.62
3-Oxoandrost-4-en-17β-yl acetate[3]	0.40	0.34	0.58	0.38
7-Oxocholest-5-en-3β-yl acetate[4,5]	0.70	0.61	0.70	0.65
7,20-Dioxopregn-5-en-3β-yl acetate[6]	0.41	0.33	0.56	0.37
7,20-Dioxopregna-5,16-dien-3β-yl acetate[7]	0.45	0.35	0.59	0.39
(25*R*)-7-Oxospirost-5-en-3β-yl acetate[7]	0.45	0.34	0.65	0.32
17-Oxo-5α-androstan-3β-yl acetate	0.63	0.56	0.66	0.61
17-Oxoandrost-5-en-3β-yl acetate	0.62	0.55	0.65	0.61
20-Oxopregna-5,16-dien-3β-yl acetate[7]	0.70	0.61	0.68	0.66
Pregna-3,5,16-triene-7,20-dione[7]	0.60	0.52	0.61	0.59
3β-Hydroxy-5α-androstan-17-one	0.23	0.17	0.29	0.18
3β-Hydroxyandrost-5-en-17-one	0.23	0.19	0.29	0.20
3β-Hydroxypregn-5-en-20-one	0.23	0.22	0.34	0.22

TABLE II

THIN-LAYER CHROMATOGRAPHY OF STEROIDAL KETOXIMES IN SOLVENT SYSTEMS 2, 3, 5 and 6

Compound	*R_F value*			
	2	*3*	*5*	*6*
3-Hydroxyiminoandrost-4-en-17β-yl acetate[3]	0.26	0.36	0.39	0.30
3-Hydroxyiminoandrost-4-en-17-one[3]	0.15	0.34	0.38	0.23
17,17-Ethylenedioxy-3-hydroxyiminoandrost-4-ene[3]	0.19	0.38	0.39	0.22
3-Hydroxyiminocholest-4-en-6-one[2]	0.34	0.41	0.39	0.36
3β-Methoxy-17-hydroxyimino-5α-androstane[8]	0.20	0.36	0.45	0.25
7-Hydroxyiminocholest-5-en-3β-yl acetate[4,5]	0.74	0.65	0.88	0.72
(25*R*)-7-Hydroxyiminospirost-5-en-3β-yl acetate[7]	0.46	0.57	0.71	0.55
7-Hydroxyiminopregn-5-ene-3β,20β-diol diacetate[7]	0.50	0.53	0.76	0.62
7,20-Dihydroxyiminopregna-5,16-dien-3β-yl acetate[7]	0.48	0.38	0.57	0.55

TABLE III

THIN-LAYER CHROMATOGRAPHY OF STEROIDAL LACTAMS IN SOLVENT SYSTEMS 7, 8, 9, 10 AND 11

Compound	R_F *value*				
	7	*8*	*9*	*10*	*11*
4-Aza-A-homocholest-4a-ene-3,6-dione[2]	0.57	0.61	0.51	0.60	0.59
3-Aza-A-homocholest-4a-ene-4,6-dione[2]	0.38	0.48	0.22	0.45	0.36
4-Aza-5α-cholestan-3-one[9]	0.49	0.51	0.13	0.55	0.31
(25*R*)-4-Aza-5β-spirostan-3-one[10]	0.51	0.49	0.11	0.58	0.30
(25*R*)-4-Aza-5α-spirostan-3-one[10]	0.47	0.48	0.06	0.53	0.34
4-Aza-5α-pregn-16-ene-3,20-dione[10]	0.46	0.44	0.10	0.50	0.27
4-Oxo-3-aza-A-homoandrost-4a-en-17β-yl acetate[3]	0.33	0.35	0.10	0.40	0.24
3-Aza-A-homoandrost-4a-ene-4,17-dione[11]	0.28	0.32	0.07	0.34	0.18
7-Oxo-7a-aza-B-homocholest-5-en-3β-yl acetate[4,5]	0.70	0.64	0.39	0.65	0.57
7a-Aza-B-homocholest-4-ene-3,7-dione[4,5]	0.74	0.61	0.64	0.63	0.62
3β-Chloro-7a-aza-B-homocholest-5-en-7-one[5]	0.75	0.65	0.47	0.67	0.59
(25*R*)-7-Oxo-7a-aza-B-homospirost-5-en-3β-yl acetate[7]	0.55	0.57	0.25	0.60	0.40
(25*R*)-3β-Hydroxy-7a-aza-B-homospirost-5-en-7-one[7]	0.16	0.37	0.06	0.43	0.15
7-Oxo-7a-aza-B-homopregn-5-ene-3,20-diol diacetate[7]	0.59	0.51	0.20	0.55	0.42
7-Oxo-7a-aza-B-homoandrost-5-ene-3,17-diol diacetate[7]	0.49	0.47	0.20	0.52	0.33
6-Aza-B-homo-5α-cholestane-3,7-dione[12]	0.38	0.47	0.21	0.50	0.31
4α-Bromo-6-aza-B-homo-5α-cholestane-3,7-dione[12]	0.48	0.54	0.54	0.60	0.47
7-Oxo-6-aza-B-homo-5α-cholestan-3β-yl acetate[12]	0.64	0.60	0.31	0.64	0.43
17a-Aza-D-homoandrost-4-ene-3,17-dione[3]	0.25	0.24	0.37	0.31	0.15
3β-Methoxy-17a-aza-D-homo-5α-androstan-17-one[8]	0.41	0.39	0.09	0.44	0.25
7,17-Dioxo-17a-aza-D-homoandrost-5-en-3β-yl acetate[13]	0.27	0.32	0.06	0.34	0.16
17a-Aza-D-homoandrosta-3,5-diene-7,17-dione[13]	0.30	0.36	0.07	0.36	0.20
3,17a-Diacetyl-3,17a-diaza-A,D-bishomoandrost-4a-ene-4,17-dione[3]	0.79	0.57	0.47	0.29	0.11
4-Benzyl-4,17a-diaza-D-homoandrost-5-ene-3,17-dione[14,15]	0.28	0.30	0.04	0.32	0.15

TABLE IV

THIN-LAYER CHROMATOGRAPHY OF STEROIDAL LACTAMS IN SOLVENT SYSTEMS 8, 12, 13 AND 14

Compound	R_F *value*			
	8	*12*	*13*	*14*
17β-Hydroxy-3-aza-A-homoandrost-4a-en-4-one[3]	0.35	0.55	0.53	0.33
17-Hydroxyimino-3-aza-A-homoandrost-4a-en-4-one[3]	0.31	0.50	0.53	0.30
16β-Bromo-17α-hydroxy-3-aza-A-homopregn-4a-ene-4,20-dione[16]	0.39	0.56	0.60	0.40
16β-Chloro-17α-hydroxy-3-aza-A-homopregn-4a-ene-4,20-dione[16]	0.38	0.58	0.61	0.39
17α-Hydroxy-16β-thiocyanato-3-aza-A-homopregn-4a-ene-4,20-dione[16]	0.37	0.54	0.59	0.40
17α-Hydroxy-16β-iodo-3-aza-A-homopregn-4a-ene-4,20-dione[16]	0.39	0.57	0.62	0.42
4,6-Diaza-A,B-bishomocholest-4a-ene-3,7-dione[2]	0.37	0.52	0.67	0.37
3,7a-Diaza-A,B-bishomocholest-4a-ene-4,7-dione[4,5]	0.32	0.53	0.58	0.31
4,6-Diaza-A,B-bishomo-5α-cholestane-3,7-dione[17]	0.25	0.31	0.49	0.21
3,6-Diaza-A,B-bishomo-5α-cholestane-4,7-dione[17]	0.31	0.41	0.54	0.26
3β-Hydroxy-7a-aza-B-homocholest-5-en-7-one[5]	0.41	0.65	0.65	0.48
(25*R*)-3-Hydroxyimino-7a-aza-B-homospirost-4-en-7-one[5]	0.42	0.64	0.64	0.51
3β-Hydroxy-7a-aza-B-homopregna-5,16-diene-7,20-dione[18]	0.32	0.55	0.56	0.34
3β,20β-Dihydroxy-7a-aza-B-homopregn-5-en-7-one[7]	0.27	0.41	0.51	0.32
3β,17β-Dihydroxy-7a-aza-B-homoandrost-5-en-7-one[7]	0.21	0.31	0.47	0.25
3-Hydroxyimino-17a-aza-D-homoandrost-4-en-17-one[3,19]	0.33	0.62	0.56	0.37
3,17a-Diaza-A,D-bishomoandrost-4a-eno-[3,4-*d*]tetrazol-17-one[20]	0.27	0.57	0.49	0.27
7-Hydroxyimino-17-oxo-17a-aza-D-homoandrost-5-en-3β-yl acetate[13]	0.36	0.60	0.55	0.39
3,17a-Diaza-A,D-bishomoandrost-4a-ene-4,17-dione[3,19]	0.16	0.33	0.41	0.16
4,17a-Diaza-D-homo-5α-androstane-3,17-dione[14,15]	0.19	0.43	0.40	0.17
7,17-Dioxo-7a,17a-diaza-B,D-bishomoandrost-5-en-3β-yl acetate[13]	0.19	0.31	0.40	0.16

For steroidal ketones, consistent results were obtained with solvent systems 1, 2, 3 and 4 (Table I), of which systems 1 and 3 are of particular interest. Of the solvent systems useful for the oximes (2, 3, 5 and 6) (Table II), systems 3 and 5 are to be preferred. For the steroidal lactams, several systems (7, 8, 9, 10, 11, 12, 13 and 14) were useful (Tables III and IV), of which solvents 8 and 10 (Table III) and 12 and 13 (Table IV) gave better results for particular compounds.

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