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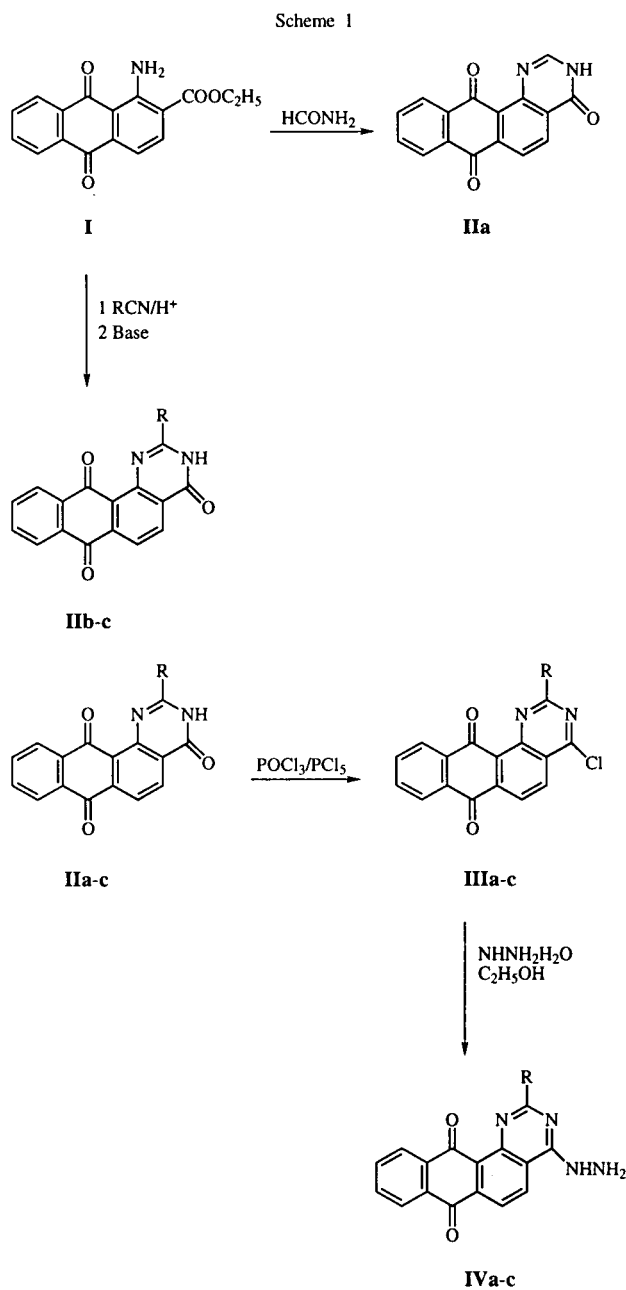
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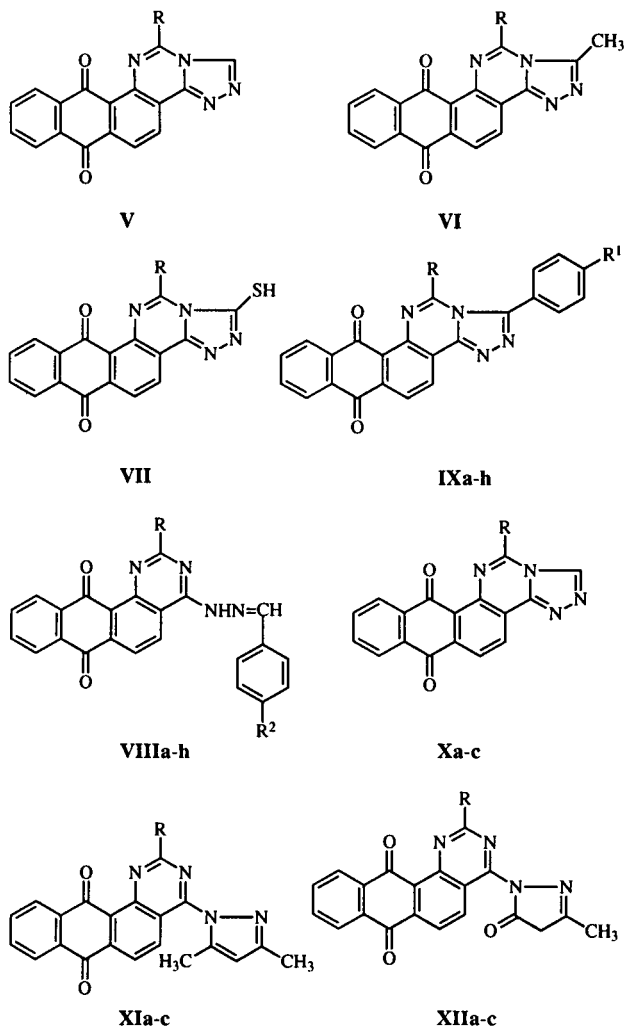
This paper describes the synthesis of 2-substituted-4(3*H*)-oxypyrimido[4,5-*a*]anthraquinone, 2-substituted-4-hydrazinopyrimido[4,5-*a*]anthraquinones, several 2-substituted-1,2,4-triazolo[4,3-*c*]pyrimido[4,5-*a*]anthraquinones tetrazolo[4,5-*c*]pyrimido[4,5-*a*]anthraquinones and pyrazolinopyrimidoanthraquinone derivatives.

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The presence of a pyrimidine ring in anti-hypertensive drugs, sedatives, anti-inflammatory agents, diuretics, hypocholesterolemic, anti-allergic and anti-tussive drugs [1-8] is well known. On the other hand, condensed 1,2,4-triazoles are biologically important compounds [9-11]. This prompted us to take up synthetic routes leading to 2-substituted pyrimido[4,5-*a*]anthraquinone and as well as the 1,2,4-triazolo[4,3-*c*]pyrimido[4,5-*a*]anthraquinone ring from which a series of such compounds could be made. Amino esters serve as good synthons for the formation of a pyrimidine ring [12]. The synthesis of a pyrimidine ring could be achieved in the following ways: 1) Reaction of enamino esters with formamide [13] or 2) reaction of enamino esters with nitriles in the presence of acid followed by base catalyzed cyclization [14]. Of the various approaches to synthesize condensed 1,2,4-triazoles the most commonly adopted approach involves the cyclization of a hydrazino compound with an appropriate 1-C donor like carboxylic acids, esters, aldehydes, acid chlorides, anhydrides or carbon disulphide [15-18].

Herein we reported the synthesis of 2-substituted pyrimido[4,5-*a*]anthraquinones and 4-hydrazino-2-substituted pyrimido[4,5-*a*]anthraquinones, followed by the preparation of fused triazolo, tetrazolo and pyrazolinopyrimido derivatives. 4(3*H*)-Oxypyrimido[4,5-*a*]anthraquinone (**IIa**) was obtained by direct reaction of the enamino esters **I** with formamide as shown in Scheme I. Nitriles on treatment with acid give rise to highly reactive imidoyl chlorides or nitrilium halides [19-20]. These reactive species can react further with an enamino ester to yield a pyrimidone. As envisaged, treatment of the enamino esters with acetonitrile and benzonitriles in the presence of dry hydrogen chloride gas and followed by base treatment furnished 2-methyl/2-phenyl-4(3*H*)-oxypyrimido[4,5-*a*]anthraquinones **IIb,c**. 4-Hydrazino-2-substituted pyrimido[4,5-*a*]anthraquinones **IVa,c** were obtained *via* nucleophilic displacement of the 4-chlorine atom of the corresponding 4-chloro-2-substituted-pyrimido[4,5-*a*]anthraquinones **IIIa,c**, in turn were prepared by the chlorination of the appropriately 2-substituted-4(3*H*)-oxypyrimido-





[4,5-*a*]anthraquinones with phosphorus oxychloride and phosphorus pentachloride. Compounds **IVa-c** when treated with acetic anhydride afforded fused triazolo compounds, namely 4-methyl-2-substituted-1,2,4-triazolo[4,3-*c*]pyrimido[4,5-*a*]anthraquinones **VIa-c**. The ir spectrum showed the absence of any absorption band in the amino region. In the same manner, **IVa-c** treated with formic acid produced 1,2,4-triazolo[4,3-*c*]pyrimido[4,5-*a*]anthraquinones **Va-c**. Refluxing **IVa-c** with carbon disulphide yields 4-mercapto-2-substituted-1,2,4-triazolo[4,3-*c*]pyrimido[4,5-*a*]anthraquinones **VIIa-c**. Treating **IVa-c** with benzaldehyde in ethanol and/or glacial acetic acid gives both 4-(benzylidenehydrazone)-pyrimido[4,5-*a*]anthraquinones **VIIIa-c** and 4-aryl-2-substituted-1,2,4-triazolo[4,3-*c*]pyrimido[4,5-*a*]anthraquinones **IXa-c**.

When **IVa-c** were treated with sodium nitrite in concentrated orthophosphoric acid, they gave the tetrazolo derivatives **Xa-c**. The ir spectra of these compounds do not show any characteristic band for the azido group at about 2000-2200  $\text{cm}^{-1}$ , thus it seems that in the solid state, **Xa-c** have essentially the tetrazole structure represented without any demonstrable contribution of the possible azido form.

Finally **IVa-c** were boiled with acetylacetone, and/or ethyl acetoacetate to give the pyrazolino derivatives, namely 2-substituted-4-(3',5'-dimethylpyrazol-1'-yl)-pyrimido[4,5-*a*]anthraquinones **XIa-c**, and 2-substituted-4-(3'-methyl-5'-oxo-2'-pyrazolin-1'-yl)pyrimido[4,5-*a*]anthraquinones **XIIa-c**.

Table I  
4-Chloro-2-substituted-pyrimido[4,5-*a*]anthraquinone

Compound No. III	R	Melting Point °C	Yield %	Molecular Formula	% N	
					Found	Calcd.
a	H	189	50	$\text{C}_{16}\text{H}_7\text{N}_2\text{O}_2\text{Cl}$	9.18	9.51
b	$\text{CH}_3$	187	53	$\text{C}_{17}\text{H}_9\text{N}_2\text{O}_2\text{Cl}$	8.98	9.08
c	$\text{C}_6\text{H}_5$	180	57	$\text{C}_{22}\text{H}_{11}\text{N}_2\text{O}_2\text{Cl}$	7.42	7.56

Table II  
4-Hydrazino-2-substituted-pyrimido[4,5-*a*]anthraquinone

Compound No. IV	R	Melting Point °C	Yield %	Molecular Formula	% N	
					Found	Calcd.
a	H	227	52	$\text{C}_{16}\text{H}_{10}\text{N}_4\text{O}_2$	19.50	19.31
b	$\text{CH}_3$	224	61	$\text{C}_{17}\text{H}_{12}\text{N}_4\text{O}_2$	18.58	18.42
c	$\text{C}_6\text{H}_5$	224	64	$\text{C}_{22}\text{H}_{14}\text{N}_4\text{O}_2$	15.42	15.30

Table III  
2-Substituted-1,2,4-triazolo[4,3-c]pyrimido[4,5-a]anthraquinone

Compound No. IV	R	Melting Point °C	Yield %	Molecular Formula	% N	
					Found	Calcd.
a	H	>330	76	C <sub>17</sub> H <sub>8</sub> N <sub>4</sub> O <sub>2</sub>	18.35	18.66
b	CH <sub>3</sub>	>330	72	C <sub>18</sub> H <sub>10</sub> N <sub>4</sub> O <sub>2</sub>	17.75	17.83
c	C <sub>6</sub> H <sub>5</sub>	>330	63	C <sub>23</sub> H <sub>12</sub> N <sub>4</sub> O <sub>2</sub>	14.80	14.89

Table IV  
2-Substituted-4-methyl-1,2,4-triazolo[4,3-c]pyrimido[4,5-a]anthraquinone

Compound No. VI	R	Melting Point °C	Yield %	Molecular Formula	% N	
					Found	Calcd.
a	H	>330	65	C <sub>18</sub> H <sub>10</sub> N <sub>4</sub> O <sub>2</sub>	18.03	17.83
b	CH <sub>3</sub>	>330	70	C <sub>19</sub> H <sub>12</sub> N <sub>4</sub> O <sub>2</sub>	17.00	17.07
c	C <sub>6</sub> H <sub>5</sub>	>330	70	C <sub>24</sub> H <sub>14</sub> N <sub>4</sub> O <sub>2</sub>	14.40	14.35

Table V  
2-Substituted-4-mercapto-1,2,4-triazolo[4,3-c]pyrimido[4,5-a]anthraquinone

Compound No. VII	R	Melting Point °C	Yield %	Molecular Formula	% N	
					Found	Calcd.
a	H	>330	74	C <sub>17</sub> H <sub>8</sub> N <sub>4</sub> O <sub>2</sub> S	17.03	16.86
b	CH <sub>3</sub>	>330	73	C <sub>18</sub> H <sub>10</sub> N <sub>4</sub> O <sub>2</sub> S	16.00	16.18
c	C <sub>6</sub> H <sub>5</sub>	>330	61	C <sub>23</sub> H <sub>12</sub> N <sub>4</sub> O <sub>2</sub> S	13.85	13.72

Table VI  
2-Substituted-4-(Arylidenehydrazono) 2-Substituted-pyrimido[4,5-a]anthraquinone

Compound No. XI	R	R'	Melting Point °C	Yield %	Molecular Formula	% N	
						Found	Calcd.
a	H	H	248	55	C <sub>23</sub> H <sub>14</sub> N <sub>4</sub> O <sub>2</sub>	14.57	14.81
b	H	NO <sub>2</sub>	274	71	C <sub>23</sub> H <sub>13</sub> N <sub>5</sub> O <sub>4</sub>	16.30	16.55
c	CH <sub>3</sub>	H	256	77	C <sub>24</sub> H <sub>16</sub> N <sub>4</sub> O <sub>2</sub>	14.15	14.29
d	CH <sub>3</sub>	NO <sub>2</sub>	287	80	C <sub>24</sub> H <sub>15</sub> N <sub>5</sub> O <sub>4</sub>	15.93	16.01
e	C <sub>6</sub> H <sub>5</sub>	H	250	74	C <sub>29</sub> H <sub>18</sub> N <sub>4</sub> O <sub>2</sub>	12.20	12.33
f	C <sub>6</sub> H <sub>5</sub>	NO <sub>2</sub>	270	61	C <sub>29</sub> H <sub>17</sub> N <sub>5</sub> O <sub>4</sub>	13.89	14.02

Table VII  
2-Substituted-4-aryl-1,2,4-triazolo[4,3-c]pyrimido[4,5-a]anthraquinone

Compound No. IX	R	R'	Melting Point °C	Yield %	Molecular Formula	% N	
						Found	Calcd.
a	H	H	>330	62	C <sub>23</sub> H <sub>12</sub> N <sub>4</sub> O <sub>2</sub>	14.96	14.89
b	H	NO <sub>2</sub>	>330	73	C <sub>23</sub> H <sub>11</sub> N <sub>5</sub> O <sub>4</sub>	16.60	16.62
c	CH <sub>3</sub>	H	>330	79	C <sub>24</sub> H <sub>14</sub> N <sub>4</sub> O <sub>2</sub>	14.49	14.36
d	CH <sub>3</sub>	NO <sub>2</sub>	>330	65	C <sub>24</sub> H <sub>13</sub> N <sub>5</sub> O <sub>4</sub>	16.23	16.09
e	C <sub>6</sub> H <sub>5</sub>	H	>330	74	C <sub>29</sub> H <sub>16</sub> N <sub>4</sub> O <sub>2</sub>	12.30	12.39
f	C <sub>6</sub> H <sub>5</sub>	NO <sub>2</sub>	>330	75	C <sub>29</sub> H <sub>15</sub> N <sub>5</sub> O <sub>4</sub>	14.17	14.08

Table VIII  
2-Substituted-1,5-tetrazolo[4,5-c]pyrimido[4,5-a]anthraquinone

Compound No. X	R	Melting Point °C	Yield %	Molecular Formula	% N	
					Found	Calcd.
a	H	>330	78	C <sub>16</sub> H <sub>7</sub> N <sub>5</sub> O <sub>2</sub>	23.08	23.26
b	CH <sub>3</sub>	>330	73	C <sub>17</sub> H <sub>9</sub> N <sub>5</sub> O <sub>2</sub>	22.15	22.22
c	C <sub>6</sub> H <sub>5</sub>	>330	83	C <sub>22</sub> H <sub>11</sub> N <sub>5</sub> O <sub>2</sub>	18.49	18.57

Table IX  
2-Substituted-4-(3',5'-dimethylpyrazol-1'-yl)pyrimido[4,5-*a*]anthraquinone

Compound No. XI	R	Melting Point °C	Yield %	Molecular Formula	% N	
					Found	Calcd.
a	H	253	54	C <sub>21</sub> H <sub>14</sub> N <sub>4</sub> O <sub>2</sub>	15.75	15.82
b	CH <sub>3</sub>	247	59	C <sub>22</sub> H <sub>16</sub> N <sub>4</sub> O <sub>2</sub>	15.20	15.22
c	C <sub>6</sub> H <sub>5</sub>	242	53	C <sub>27</sub> H <sub>18</sub> N <sub>4</sub> O <sub>2</sub>	12.85	13.02

Table X  
2-Substituted-4-(3'-methyl-5'-oxo-2'-pyrazolin-1'-yl)pyrimido[4,5-*a*]anthraquinone

Compound No. XII	R	Melting Point °C	Yield %	Molecular Formula	% N	
					Found	Calcd.
a	H	276	61	C <sub>20</sub> H <sub>12</sub> N <sub>4</sub> O <sub>3</sub>	16.68	15.72
b	CH <sub>3</sub>	270	67	C <sub>21</sub> H <sub>14</sub> N <sub>4</sub> O <sub>3</sub>	14.86	15.13
c	C <sub>6</sub> H <sub>5</sub>	268	60	C <sub>26</sub> H <sub>16</sub> N <sub>4</sub> O <sub>3</sub>	12.99	12.96

## EXPERIMENTAL

All melting points are in degrees Celsius and uncorrected. The ir spectra were recorded on a Perkin-Elmer 157 spectrophotometer using potassium bromide. The <sup>1</sup>H nmr spectra were obtained on a Varian Gemini 300 MHz spectrophotometer using TMS as the internal standard. Chemical shifts are expressed in δ PPM. The mass spectra were obtained on a Kartos MS 80 RFA.

### 4(3*H*)-Oxypyrimido[4,5-*a*]anthraquinone (IIa).

To 0.591 g (0.002 mole) of ethyl 1-aminoanthraquinone-2-carboxylate was added 25 ml of formamide. The reaction mixture was refluxed in an oil-bath, 160-180° for 14 hours, at the end of which it was concentrated, cooled and poured into ice water. The solid separated which was filtered, dried and recrystallized from aqueous dimethylformamide (95:5), mp >330°, yield 80%; ir (potassium bromide): 3429, 3290 cm<sup>-1</sup>; <sup>1</sup>H nmr (DMSO-d<sub>6</sub>) 7.6-8.5 (6H, aromatic), 8.7 (s, 1H, CH=N); ms: m/z 276, 246, 232, 203.

### 2-Methyl-4(3*H*)-oxypyrimido[4,5-*a*]anthraquinone (IIb).

To 0.591 g (0.002 mole) of ethyl 1-aminoanthraquinone-2-carboxylate was added 5 ml (excess) of acetonitrile in 10 ml of dioxane as the solvent. Dry hydrogen chloride gas was next passed through the solution for 24 hours, keeping the reaction mixture at room temperature. The reaction mixture was then allowed to stand overnight. The solid was filtered, dissolved in water and basified with sodium carbonate. The solid that precipitated was filtered, washed with water and dried. This intermediate was dissolved in 20 ml of ethanol and 5 ml of 6% aqueous sodium hydroxide. The reaction mixture was then refluxed for 6 hours. The solvent was evaporated and the product was dissolved in water and acidified with glacial acetic acid. The solid which precipitated was filtered and recrystallized from dimethylformamide:ethanol (80:20), mp 295°, yield 50%; <sup>1</sup>H nmr (DMSO-d<sub>6</sub>): 2.5 (s, 3H, CH<sub>3</sub>), 7.4-8.3 (m, 6H, aromatic), 9.0-9.4 (s, 1H, NH). The procedure for the 2-methyl derivative described above was repeated, using 0.206 g (0.002 mole) benzonitrile instead of acetonitrile, mp 278° and yield 73%.

### 4-Chloro-2-substituted Pyrimido[4,5-*a*]anthraquinones IIIa-c.

To 0.002 mole of 2-substituted-4(3*H*)-oxypyrimido[4,5-*a*]anthraquinone was added 100 ml of phosphorus oxychloride and

2.0 g phosphorus pentachloride and heated under reflux in an oil bath (110-120°) for 18 hours. Excess phosphorus oxychloride was distilled off under vacuum. The reaction mixture was cooled and poured into a mixture of ice and water and sodium bicarbonate. The solid was filtered, dried and recrystallized from dioxane, Table I.

### 4-Hydrazino-2-substituted Pyrimido[4,5-*a*]anthraquinones Va-c.

To 0.001 mole of 4-chloro-2-substituted pyrimido[4,5-*a*]anthraquinone, dissolved in 100 ml of hot ethanol was added 0.004 mole (excess) of hydrazine hydrate (98%). The reaction mixture was then heated under reflux in a water bath for 12 hours. The product obtained was concentrated to 10 ml and cooled. The solid was filtered, dried and recrystallized from benzene:petroleum ether (60-80°) 95:5%, Table II.

4-Hydrazinopyrimido[4,5-*a*]anthraquinone had <sup>1</sup>H nmr (DMSO-d<sub>6</sub>): 5.6 (s, 2H, NH<sub>2</sub>), 7.2-8.4 (m, 7H, aromatic), 9.1 (bs, 1H, NH).

4-Hydrazino-2-methylpyrimido[4,5-*a*]anthraquinone had <sup>1</sup>H nmr (DMSO-d<sub>6</sub>): 2.5 (s, 3H, CH<sub>3</sub>), 7.4-8.0 (m, 6H, aromatic), 9.0 (bs, 1H, NH).

### 2-Substituted-1,2,4-triazolo[4,3-*c*]pyrimido[4,5-*a*]anthraquinones Va-c.

To 0.002 mole of the 4-hydrazino-2-substituted-pyrimido[4,5-*a*]anthraquinone was added 10 ml (excess) of formic acid in the presence of catalytic amounts of 4-toluenesulphonic acid. The reaction mixture was then refluxed for 7 hours and excess formic acid was distilled under vacuum. The residue was cooled and to it was added 100 ml of ice cold water and the mixture shaken. It was filtered and the precipitate obtained was washed with sodium bicarbonate to remove excess formic acid. The triazoles obtained were recrystallized from dimethylformamide, Table III.

1,2,4-Triazolo[4,3-*c*]pyrimido[4,5-*a*]anthraquinone had <sup>1</sup>H nmr (DMSO-d<sub>6</sub>): 7.2-8.3 (m, 6H, aromatic), 8.6 (s, 1H, CH=N), 10.4 (s, 1H, N=CH-N).

### 2-Substituted-4-methyl-1,2,4-triazolo[4,3-*c*]pyrimido[4,5-*a*]anthraquinones VIa-c.

To 0.002 mole of the 4-hydrazino-2-substituted-pyrimido[4,5-*a*]anthraquinone was added 15 ml (excess) of acetic anhy-

dride and catalytic amounts of 4-toluenesulphonic acid. The reaction mixture was heated at reflux temperature for 9 hours. The product was cooled and poured into cold water and neutralized with a solution of sodium carbonate and allowed to stand overnight at room temperature. It was filtered, washed with water, dried and recrystallized from aqueous dimethylformamide, Table IV.

4-Methyl-1,2,4-triazolo[4,3-c]pyrimido[4,5-a]anthraquinone had  $^1\text{H}$  nmr (DMSO- $d_6$ ) 2.2 (s, 3H,  $\text{CH}_3$ ), 7.8-8.2 (m, 6H, aromatic), 8.5 (s, 1H,  $\text{CH}=\text{N}$ ).

2-Substituted-4-mercapto-1,2,4-triazolo[4,3-c]pyrimido[4,5-a]anthraquinones VIIa-c.

To 0.002 mole of the 4-hydrazino-2-substituted-pyrimido[4,5-a]anthraquinone dissolved in 2 ml of warm pyridine was added 30 ml (excess) of carbon disulphide. The mixture was then refluxed in a water bath for 7 hours. At the end of the reaction, excess of carbon disulphide was removed by distillation and the residue poured into cold water containing 15 ml of hydrochloric acid. The precipitate obtained was filtered, washed with water, dried and recrystallized from dimethylformamide, Table V.

4-Mercapto-1,2,4-triazolo[4,3-c]pyrimido[4,5-a]anthraquinone had ir (potassium bromide): 3319  $\text{cm}^{-1}$  for NH;  $^1\text{H}$  nmr (DMSO- $d_6$ ): 7.6-8.4 (m, 6H, aromatic), 8.6 (s, 1H,  $\text{CH}=\text{N}$ ), 13.1 (bs, 1H, SH).

Condensation of 4-Hydrazino-2-substituted-pyrimido[4,5-a]anthraquinones with Aromatic Aldehydes VIIIa-f.

To 0.001 mole of the 4-hydrazino-2-substituted-pyrimido[4,5-a]anthraquinone dissolved in 50 ml of absolute ethanol was added 0.001 mole of the required aromatic aldehyde. The reaction mixture was refluxed in a water bath for 6 hours. The solid which separated on cooling was filtered and recrystallized from dimethylformamide, Table VI.

4-(Benzylidenehydrazono)pyrimido[4,5-a]anthraquinone had ir (potassium bromide): 3180, 3430  $\text{cm}^{-1}$  for NH; 1686, 1620  $\text{cm}^{-1}$  for C=O, C=N respectively;  $^1\text{H}$  nmr (DMSO- $d_6$ ): 7.2 (s, 5H, aromatic), 7.6-8.1 (m, 6H, aromatic), 8.4 (s, 1H,  $=\text{CH}-\text{Ph}$ ), 8.7 (s, 1H,  $\text{CH}=\text{N}$ ), 9.1 (bs, 1H, NH).

2-Substituted-4-aryl-1,2,4-triazolo[4,3-c]pyrimido[4,5-a]anthraquinones IXa-f.

To 0.001 mole of 4-hydrazino-2-substituted-pyrimido[4,5-a]anthraquinone in 20 ml of glacial acetic acid was added 0.001 mole the required aromatic aldehyde. The mixture was refluxed in an oil bath for 16 hours. After cooling the solid which separated was recrystallized from dimethylformamide, Table VII.

The respective product had ir (potassium bromide): 1680, 1620  $\text{cm}^{-1}$  for C=O and C=N respectively with no absorption band in the region of  $\text{NH}_2$  group. The same product were obtained from the corresponding hydrazones VIIIa-c on refluxing in glacial acetic acid for 12 hours.

2-Substituted-1,5-tetrazolo[4,5-c]pyrimido[4,5-a]anthraquinones Xa-c.

4-Hydrazino-2-substituted-pyrimido[4,5-a]anthraquinone (0.001 mole) was dissolved in 15 ml of concentrated orthophosphoric acid. The mixture was cooled to 0-5° in an ice bath and 12 ml of 2N sodium nitrite gradually added to the hydrazine with mechanical stirring over a period of 7 hours. After the addi-

tion of sodium nitrite was completed the temperature was allowed to rise to room temperature, where it was stirred for a further period of 24 hours. As the reaction proceeded the product separated out. The mixture was poured into 50 ml of cold water, dried and recrystallized from dimethylformamide, Table VIII.

1,5-Tetrazolo[4,5-c]pyrimido[4,5-a]anthraquinones had  $^1\text{H}$  nmr (DMSO- $d_6$ ) 7.6-8.4 (m, 6H, aromatic), 10.4 (s, 1H,  $\text{CH}=\text{N}$ ).

2-Substituted-4-(3',5'-dimethylpyrazolo-1'-yl)pyrimido[4,5-a]anthraquinones XIa-c.

4-Hydrazino-2-substituted-pyrimido[4,5-a]anthraquinone (0.001 mole) dissolved in 50 ml of hot ethanol was added 0.0015 mole of acetylacetone along with a few drops of glacial acetic acid. The reaction mixture was then heated under reflux for 6 hours at the end of which time the mixture was cooled. The product that precipitated was filtered, washed with 10 ml of cold methanol, dried and recrystallized from aqueous dimethylformamide, Table VIII.

The 4-(3',5'-dimethylpyrazolo-1'-yl)pyrimido[4,5-a]anthraquinone had  $^1\text{H}$  nmr (DMSO- $d_6$ ): 2.35 (s, 3H,  $\text{CH}_3$ ) 2.5 (s, 3H,  $\text{CH}_3$ ), 6.18 (s, 1H,  $=\text{CH}$ ), 7.4-8.0 (m, 6H, aromatic), 8.9 (bs, 1H,  $\text{CH}=\text{N}$ ).

2-Substituted-4-(3'-methyl-5'-oxo-2'-pyrazoline-1'-yl)pyrimido[4,5-a]anthraquinones XIIa-c.

4-Hydrazino-2-substituted-pyrimido[4,5-a]anthraquinone (0.001 mole) was dissolved in 50 ml of hot ethanol to which was subsequently added 0.0015 mole of ethyl acetoacetate along with a few drops of glacial acetic acid. The reaction mixture was then heated under reflux for 10 hours. On cooling, the solid that separated was filtered, washed with 10 ml of cold methanol, dried and recrystallized from aqueous dimethylformamide, Table IX.

4-(3'-Methyl-5'-oxo-2'-pyrazoline-1'-yl)pyrimido[4,5-a]anthraquinone had  $^1\text{H}$  nmr (DMSO- $d_6$ ): 2.3 (s, 3H,  $\text{CH}_3$ ), 4.2 (s, 1H, pyrazolone proton), 7.4-7.9 (m, 6H, aromatic), 9.1 (s, 1H,  $\text{CH}=\text{N}$ ), 12.1 (b, 1H, OH).

## REFERENCES AND NOTES

- [1] A. Scriabine, J. W. Constantine, H.-J. Hess and W. K. McShane, *Experientia*, **24**, 1150, (1968).
- [2] J. Castaner, *Drugs of the Future*, Vol **11**, 1977, p 383.
- [3] M. B. Manhas, S. D. Sharma and S. G. Amin, *J. Med. Chem.*, **15**, 106 (1972).
- [4] M. B. Devani, C. J. Shishoo, U. S. Pathak, S. H. Parikh, G. F. Shah and A. C. Padhya, *J. Pharm. Sci.*, **65**, 660 (1976).
- [5] German patent 2,264,222 (1973); *Chem. Abstr.*, **79**, 78837d (1973).
- [6] Belgian patent 769,844 (1972); *Chem. Abstr.*, **77**, 5512 (1972).
- [7] K. Thomas, British patent 1,057,612 (1967); *Chem. Abstr.*, **67**, 100149g (1967).
- [8] F. Sauter, German patent 2,210,503 (1972); *Chem. Abstr.*, **77**, 164752n (1972).
- [9] J. J. Wade, US patent 4,528,288 (1985); *Chem. Abstr.*, **104**, 5889x (1986).
- [10] J. E. Francis and K. O. Gelotte, US patent 4,713,383 (1987); *Chem. Abstr.*, **109**, 129041n (1988).
- [11] K. Kottke, H. Kuehmstedt, V. Hagen and H. Renner, East German Patent, 158,549 (1983); *Chem. Abstr.*, **99**, 70757v (1983).

- [12] H. Wamhoff, Lectures in Heterocyclic Chemistry, Vol V, 1980, S. 61 and the references cited therein.
- [13] O. Yu. Magidson and R. G. Glushkov, U.S.S.R. 177,892, *Chem. Abstr.*, **64**, 19634h (1966).
- [14] K. G. Dave, C. J. Shishoo and M. B. Devani, *J. Heterocyclic Chem.*, **17**, 1497 (1980).
- [15] J. B. Polya, Comperhensive Heterocyclic Chemistry, Vol 5, A. R. Katritzky and C. W. Rees, eds, Pergamon Press, Oxford, 1984 p 762.
- [16] H. A. El-Sherif, A. E. Abdel-Rehman, G. M. El-Naggar and A. M. Mahmond, *Bull. Chem. Soc. Japan*, **56**, 1227 (1983).
- [17] H. Wammof and L. Lichtenthaler, *Chem. Ber.*, **111**, 2297 (1978).
- [18] W. R. Tully, R. Westwood and D.A. Rowlands and S. Clements-Jewery, European Patent 76199 (1981); *Chem. Abstr.*, **99**, 194989s (1983).
- [19] H. Ulrich, The Chemistry of Imidoyl Halides, Plenum Press, New York, NY, 1968, Chapter 3.
- [20] F. Jonson and R. Madronero, Advance In Heterocyclic Chemistry, Vol 6, A. R. Katritzky, ed, Academic Press, New York, NY, 1966, p 95.