Monatshefte für Chemie 129, 871–885 (1998)

Monatshefte für Chemie
Chemical Monthly

Printed in Austria

Synthesis of Tricarbonylmethane Derivatives of Pyridines, Pyrimidines, Pyridazines, and Pyrazoles by Anionic *ortho-Fries* Rearrangement

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Summary. Heterocyclic 1,3-dicarbonyl systems, such as 4-hydroxy-2-pyridones, 6-hydroxy-4-pyrimidones, and 5-hydroxy-1-phenyl-3-pyrazolones, are converted with a number of aromatic acid chlorides to their enol esters which can be rearranged in the presence of KCN, triethylamine, and 18-crown-6 as catalyst to yield heterocyclic aryl ketones. This reaction can also be performed in a one-pot procedure without isolation of the esters. Aryl esters of 5-hydroxy-3-pyridazinone can be prepared in the same manner, but not be rearranged.

Keywords. Anionic *ortho-Fries* rearrangement; 4-Hydroxy-2(1*H*)-pyridones; 6-Hydroxy-4(3*H*)-pyrimidones; 5-Hydroxy-3(2*H*)-pyridazinones; Pyrazolidine-3,5-diones.

Synthese von Tricarbonylmethanderivaten des Pyridins, Pyrimidins und Pyrazols durch anionische *ortho-Fries* Umlagerung

Zusammenfassung. Heterocyclische 1,3-Dicarbonylsysteme (''Malonylheterocyclen'') wie 4-Hydroxy-2-pyridone, 6-Hydroxy-4-pyrimidone und 5-Hydroxy-3-pyrazolone (''Pyrazolin-3,5-dione'') werden mit aromatischen Säurechloriden in ihre Enolester übergeführt, welche mit Hilfe von KCN, Triethylamin und 18-Crown-6 als Katalysator in Arylketone umgelagert werden. Diese Reaktion kann auch als Eintopfverfahren ohne Isolierung der Ester durchgeführt werden. Arylester des 5-Hydroxy-3-pyridazinones können auf die gleiche Art hergestellt, aber nicht umgelagert werden.

Introduction

The 4-hydroxy-2(1*H*)-pyridone system is noteworthy for several reasons. The fundamental structure can be found in many natural products, such as flavipucin [1], the long known and highly toxic ricinine [2, 3], and the yellow pigments bassianin [4] and tenellin [5]. The latter two compounds have a 3-acyl-4-hydroxy-

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[a] Dedicated to Prof. *Gottfried Heinisch* on the occasion of his 60th birthday

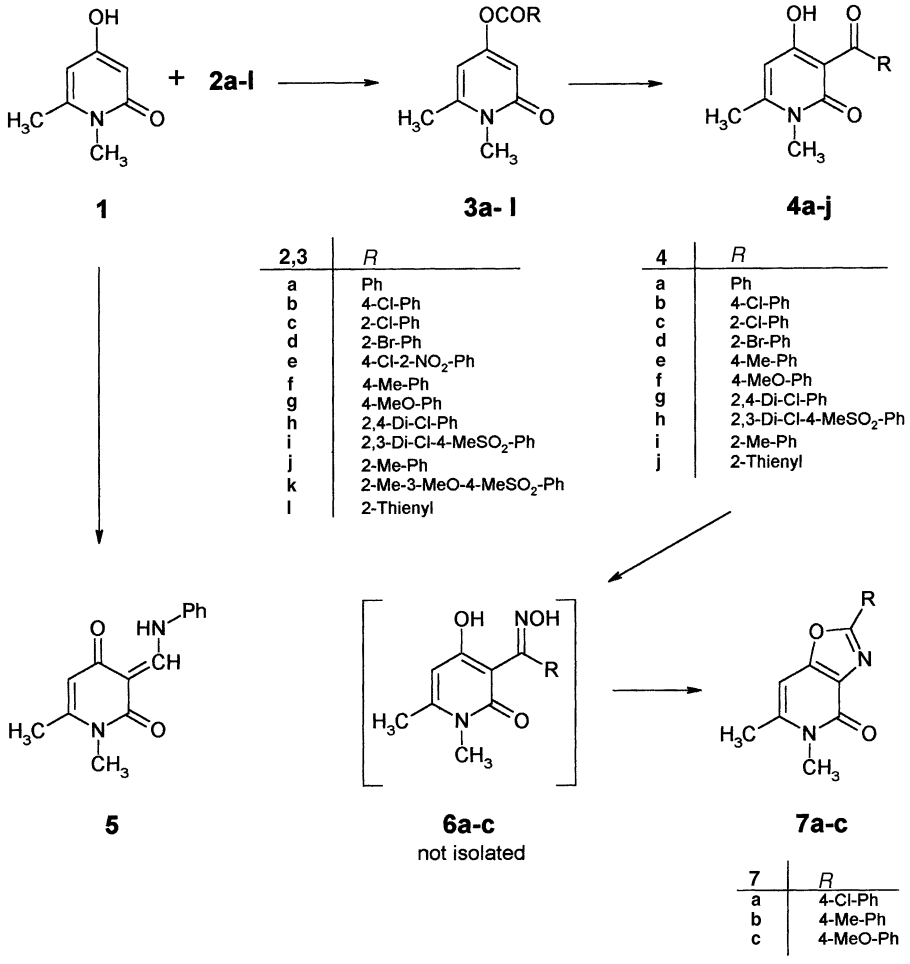
2-pyridone skeleton, a structural moiety which is common for a large number of antibiotic substances such as ilicicolin H [6], funiculosin [7], harzianopyridon [8], sambutoxin [9], mocimycin [10], and aurodox [10], produced by a variety of *Streptomyces* species. Moreover, substances with this structure belong to the large group of so-called ''cyclic tricarbonylmethane compounds'' which play an important role in agricultural chemistry, whether they are carbocyclic or heterocyclic, oximated or not [11, 12].

In recent years we have developed an easy entrance to the field of aliphatic 3-acyl derivatives in this series of heterocycles by ring opening of pyrono derivatives [13–15]. However, aroyl derivatives of this type are not accessible by this route. Therefore, we have tried the classical and the anionic *Fries* rearrangement with 4-aroyloxy-2-quinolones and coumarins [12, 16]. We have now extended this procedure to obtain heterocyclic tricarbonylmethane compounds with potential herbicidal activity by introducing the appropriate aroyl substituents into 4-hydroxy-2(1*H*)-pyridones (**1**), 6-hydroxy-4(3*H*)-pyrimidones (**8**), 5-hydroxy-3(2*H*)-pyridazinones (**11**), and pyrazolidine-3,5-diones (**17**).

Results and Discussion

The starting ''malonyl heterocycles'' **1**, **8**, **11**, and **17** represent enolized heterocyclic 1,3-dicarbonyl systems and can be converted conveniently to their arylesters (**3a–l**, **9a–m**, **12a–c**, and **18a–e**), by two methods. With method A, two equivalents of the acid chlorides **2** are reacted with the educts in sodium carbonate solution. However, under these conditions the acid chlorides are partially hydrolyzed. Since some of them are expensive, the preferred mode of preparation uses only a small excess (20%) of **2** in dry toluene with one equivalent of triethylamine as base (Method B). This method is also advantageous since it allows to perform a one-pot reaction sequence from the starting substances **1**, **8**, and **17** directly to the rearranged ketones **4**, **10**, and **16** as shown in the next paragraph.

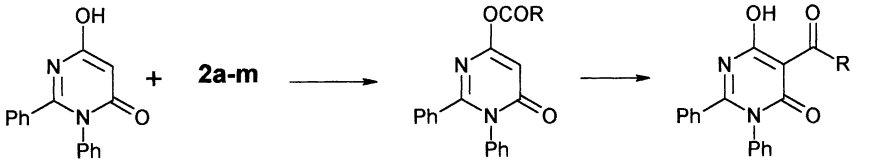
As noted before, the *Lewis* acid catalyzed *Fries* rearrangement of aromatic esters of malonyl heterocycles works only with the unsubstituted benzoyl ester [12]. *Fries* rearrangement reactions catalyzed with 4-dimethylaminopyridine [17] or cyanide (in the form of acetone cyanohydrine) in the presence of triethylamine in acetonitrile have been described for 1,3-cyclohexanedione derivatives [18]. Experiments with substrates **3**, **9**, **12**, and **18** under these conditions were unsuccessful. However, the use of KCN (2 equivalents), triethylamine (1 equivalent), and a catalytic amount of 18-crown-6 in toluene gave the rearranged compounds in good yields. The use of acetonitrile as solvent lead to a number of side products. The mechanism of this variety of the *Fries* rearrangement is not yet resolved. It may be assumed that under the reaction conditions small amounts of aroylonitriles and the anions of the heterocycles are generated and that these two intermediates give the thermodynamically more stable C-acylated compounds. As already mentioned, the mode of the ester preparation using **2** and triethylamine in toluene allows a one-pot preparation of the rearranged products **4** and **10** if KCN and 18-crown-6 as catalysts are added after completion of the esterification. Most of the ketones were prepared by this direct method (A).



Scheme 1

Aliphatic ketones of type **4** are easily converted to their oximes or oxime ethers [19]. In view of the potential herbicidal activity of such derivatives we have prepared the oximes **6a–c**, but obtained a mixture of isomers (*E*/*Z* isomers and oxim-enol/hydroxyaminomethylene ketone tautomers [20] are possible). Therefore, we have converted these mixtures directly by thermal *Beckmann* rearrangement [19] to the oxazolo[4,5-*c*]pyridones **7a–c**. The three component reaction of **1** with triethyl orthoformiate and aniline lead to the phenylaminomethylene-pyridine-dione **5**.

The 5-hydroxy-3-pyridazinone **11** was readily converted to the ester **12** with **2** and triethylamine in toluene; however, all attempts to rearrange these derivatives to the ketones **13** failed (Scheme 3). The 5-hydroxy-3-chloro-pyridazine **14** could also be reacted by this method to its esters **15a–c**. The attempted *Fries* rearrangement of **15a** under standard conditions with KCN led to the phenyl ketone **16** in which the chloro atom was exchanged against the cyano group; the yield of **16** was, however, 20% only (Scheme 3).

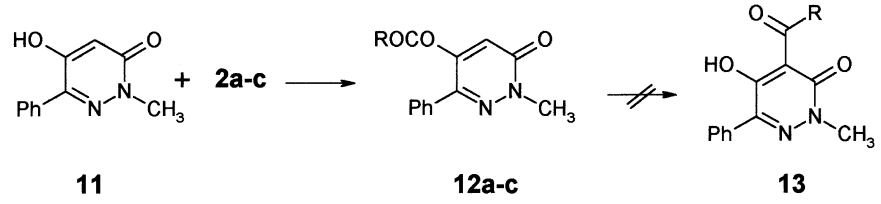


8 **9a-m** **10a-i**

2,9	*R*
a	Ph
b	4-Cl-Ph
c	2-Cl-Ph
d	2-Br-Ph
e	4-Cl-2-NO_2-Ph
f	4-Me-Ph
g	4-MeO-Ph
h	2,4-Di-Cl-Ph
i	2,3-Di-Cl-4-$MeSO_2$-Ph
j	2-Me-Ph
k	2-Me-3-MeO-4-$MeSO_2$-Ph
l	2-Thienyl
m	3-Pyridyl

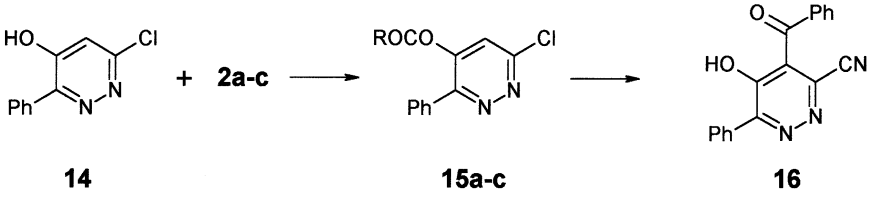
10	*R*
a	Ph
b	4-Cl-Ph
c	2-Cl-Ph
d	2-Br-Ph
e	4-Cl-2-NO_2-Ph
f	4-Me-Ph
g	4-MeO-Ph
h	2,4-Di-Cl-Ph
i	2-Thienyl

Scheme 2



11 **12a-c** **13**

2,12	*R*
a	Ph
b	4-Cl-Ph
c	4-MeO-Ph

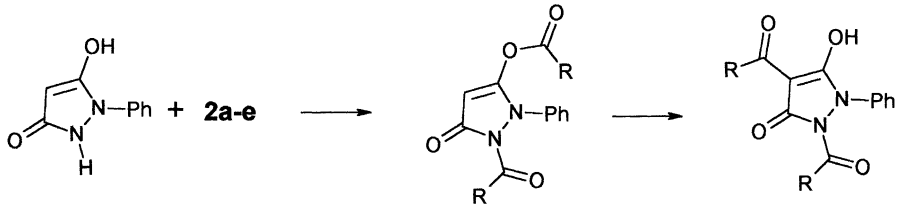


14 **15a-c** **16**

2,15	*R*
a	Ph
b	4-Cl-Ph
c	4-MeO-Ph

Scheme 3

The 5-membered hydroxypyrazolone **17** (usually described as 1-phenyl-pyrazolidin-3,5-dione) leads to the formation of the O- and N-acylated compounds **18a–e** with 2 equivalents of **2** according to Method B (Scheme 4). The anionic *Fries* rearrangement was successfully tested with two derivatives to afford **19a** and **19b** (55% and 89% yield, respectively).



17 **18a-e** **19a,b**

2,18	R
a	Ph
b	4-Cl-Ph
c	2-Cl-Ph
d	4-Me-Ph
e	2,4-Di-Cl-Ph

19	R
a	4-Cl-Ph
b	4-Me-Ph

Scheme 4

Experimental

Melting points were obtained on a Gallenkamp melting point apparatus, Mod. MFB-595 (open capillary tubes). IR spectra were recorded on a Perkin-Elmer 298 spectrometer; (KBr-pellets). ^{1}H NMR spectra were recorded on a Varian Gemini 200 instrument (*TMS* as internal standard, δ values in ppm, *DMSO*-d_6 as solvent). Elemental analyses were performed on a C,H,N-Automat Carlo Erba 1106; they agreed with the calculated values ($\pm$0.4%).

General procedure for the synthesis of 4-benzoyloxy-1,6-dimethyl-2(1H)-pyridones **3a–l**, *6-benzoyloxy-2,3-diphenyl-4(3H)-pyrimidones* **9a–m**, *benzoyloxy-2-methyl-6-phenyl-3(2H)-pyridazones* **12a–c**, *and 5-benzoyloxy-3-chloro-6-phenyl-pyridazines* **15a–c**

Method A

6-Hydroxy-2,3-diphenyl-4(3*H*)-pyrimidone (**8**) [21] (10 mmol) and the corresponding acid chloride **2** (20 mmol) were stirred for 24 h in aqueous sodium carbonate solution (16 g $Na_2CO_3 \cdot 10\,H_2O$ in 40 ml water). The product was filtered by suction, washed with water, and dried.

Method B

To a solution of 4-hydroxy-1,6-dimethyl-2(1*H*)-pyridone (**1**) [22] or **8** (10 mmol) in 50 ml of dry toluene the corresponding acid chloride **2** (12 mmol) and Et_3N (10 mmol) were added. The solution was heated for 5 h under reflux. After cooling to room temperature, 60 ml of CH_2Cl_2 were added, and the mixture was washed several times with dilute HCl in a separatory funnel. The organic phase was dried over Na_2SO_4, and the solvent was removed by evaporation.

4-Benzoyloxy-1,6-dimethyl-2(1H)-pyridone (**3a**; $C_{14}H_{13}NO_3$)

Prepared by method B in 72% yield; m.p.: 115–118°C (toluene); IR: $\nu = 3600$–3280 wb, 3080 w, 1745 s, 1650 s, 1580 s, 1560 s cm^{-1}; ^{1}H NMR (200 MHz, δ, *DMSO*-d_6): 2.40 (s, 3H, CH_3), 3.42 (s, 3H, NCH_3), 6.23 (s, 2H, 3-H, 5-H), 7.55–7.80 (m, 3H, phenyl-H), 8.08 (dd, $J = 7$ and 1.5 Hz, 2H, phenyl 2-H, 6-H) ppm.

4-(4-Chlorobenzoyloxy)-1,6-dimethyl-2(1H)-pyridone (**3b**; $C_{14}H_{12}ClNO_3$)

Prepared by method B in 82% yield; m.p.: 145–148°C (1-butanol); IR: $\nu = 3080$ w, 1740 s, 1660–1645 s, 1590 s, 1565 m cm^{-1}; ^{1}H NMR (200 MHz, δ, *DMSO*-d_6): 2.40 (s, 3H, CH_3), 3.48 (s, 3H, NCH_3), 6.28 (s, 2H, 3-H, 5-H), 7.70 (d, $J = 8$ Hz, 2H, phenyl 3-H, 5-H), 8.12 (d, $J = 8$ Hz, 2H, phenyl 2-H, 6-H) ppm.

4-(2-Chlorobenzoyloxy)-1,6-dimethyl-2(1H)-pyridone (**3c**; $C_{14}H_{12}ClNO_3$)

Prepared by method B in 52% yield; m.p.: 105–109°C (ethanol); IR: $\nu = 3580$–3320 wb, 1760 s, 1650 s, 1570 s cm^{-1}; ^{1}H NMR (200 MHz, δ, *DMSO*-d_6): 2.41 (s, 3H, CH_3), 3.44 (s, 3H, NCH_3), 6.28 (s, 2H, 3-H, 5-H), 7.50–7.60 (m, 1H, aryl-H), 7.65–7.70 (m, 2H, aryl-H), 8.05 (dd, $J = 7$ and 1.5 Hz, 1H, phenyl 6-H) ppm.

4-(2-Bromobenzoyloxy)-1,6-dimethyl-2(1H)-pyridone (**3d**; $C_{14}H_{12}BrNO_3$)

Prepared by method B in 59% yield; m.p.: 104–106°C (toluene).

4-(4-Chloro-2-nitrobenzoyloxy)-1,6-dimethyl-2(1H)-pyridone (**3e**; $C_{14}H_{11}ClN_2O_5$)

Prepared by method B in 56% yield; m.p.: 138–141°C (ethanol).

4-(4-Methylbenzoyloxy)-1,6-dimethyl-2(1H)-pyridone (**3f**; $C_{15}H_{15}NO_3$)

Prepared by method B in 89% yield; m.p.: 138–140°C (1-butanol); IR: $\nu = 3080$–2850 wb, 1740 s, 1650 s, 1595 s, 1565 s cm^{-1}; ^{1}H NMR (200 MHz, δ, *DMSO*-d_6): 2.40 (s, 3H, CH_3), 2.42 (s, 3H, CH_3), 3.45 (s, 3H, NCH_3), 6.24 (s, 2H, 3-H, 5-H), 7.42 (d, $J = 8$ Hz, 2H, phenyl 3-H, 5-H), 8.00 (d, $J = 8$ Hz, 2H, phenyl 2-H, 6-H) ppm.

4-(4-Methoxybenzoyloxy)-1,6-dimethyl-2(1H)-pyridone (**3g**; $C_{15}H_{15}NO_4$)

Prepared by method B in 76% yield; m.p.: 161–164°C (ethanol); IR: $\nu = 3080$–2840 wb, 1725 s, 1655 s, 1605 s, 1580 m, 1560 s cm^{-1}; ^{1}H NMR (200 MHz, δ, *DMSO*-d_6): 2.39 (s, 3H, CH_3), 3.43 (s, 3H, NCH_3), 3.89 (s, 3H, OCH_3), 6.21 (s, 2H, 3-H, 5-H), 7.10 (d, $J = 7$ Hz, 2H, phenyl 3-H, 5-H), 8.02 (d, $J = 8$ Hz, 2H, phenyl 2-H, 6-H) ppm.

4-(2,4-Dichlorobenzoyloxy)-1,6-dimethyl-2(1H)-pyridone (**3h**; $C_{14}H_{11}Cl_2NO_3$)

Prepared by method B in 83% yield; m.p.: 127–131°C (ethanol); IR: $\nu = 3100$–2850 wb, 1742 m, 1718 m, 1665 s, 1585 m, 1555 s cm^{-1}; ^{1}H NMR (200 MHz, δ, *DMSO*-d_6): 2.40 (s, 3H, CH_3), 3.45 (s, 3H, NCH_3), 6.45 (s, 2H, 3-H, 5-H), 7.65 (dd, $J = 7$ and 1.5 Hz, 1H, phenyl 5-H), 7.88 (d, $J = 1.5$ Hz, 1H, phenyl 3-H), 8.10 (d, $J = 8$ Hz, 1H, phenyl 6-H) ppm.

4-(2,3-Dichloro-4-methylsulfonylbenzoyloxy)-1,6-dimethyl-2(1H)-pyridone (**3i**; $C_{15}H_{13}Cl_2NO_5S$)

Prepared by method B in 51% yield; m.p.: 150–154°C (1-butanol).

4-(2-Methylbenzoyloxy)-1,6-dimethyl-2(1H)-pyridone (**3j**; $C_{15}H_{15}NO_3$)

Prepared by method B in 60% yield; m.p.: 89–92°C (ethanol); IR: $\nu = 3080$–2840 w, 1740 s, 1640 s, 1595 m, 1560 m cm^{-1}; ^{1}H NMR (200 MHz, δ, *DMSO*-d_6): 2.42 (s, 3H, CH_3), 2.62 (s, 3H, CH_3), 3.48

(s, 3H, NCH_3), 6.28 (d, $J = 2$ Hz, 2H, 3-H, 5-H), 7.28–7.68 (m, 3H, phenyl H), 8.05 (dd, $J = 7$ and 1.5 Hz, 1H, phenyl 6-H) ppm.

4-(2-Methyl-3-methoxy-4-methylsulfonylbenzoyloxy)-1,6-dimethyl-2(1H)-pyridone (**3k**; $C_{17}H_{19}NO_6S$)

Prepared by method B in 66% yield; m.p.: 185–187°C (ethanol); IR: $\nu = 3100$–2820 w, 1735 s, 1650 s, 1585 w, 1560 s cm^{-1}; ^1H NMR (200 MHz, δ, *DMSO*-d_6): 2.42 (s, 3H, CH_3), 2.53 (s, 3H, phenyl-CH_3), 3.38 (s, 3H, SO_2CH_3), 3.48 (s, 3H, NCH_3), 3.92 (s, 3H, OCH_3), 6.30 (s, 2H, 3-H, 5-H), 7.85 (d, $J = 8$ Hz, 1H, phenyl 5-H), 7.98 (d, $J = 8$ Hz, 1H, phenyl 6-H) ppm.

4-(2-Thienylcarbonyloxy)-1,6-dimethyl-2(1H)-pyridone (**3l**; $C_{12}H_{11}NO_3S$)

Prepared by method B in 64% yield; m.p.: 118–120°C (toluene); IR: $\nu = 3110$–2910 w, 1720 s, 1665 s, 1590 m cm^{-1}; ^1H NMR (200 MHz, δ, *DMSO*-d_6): 2.38 (s, 3H, CH_3), 3.42 (s, 3H, NCH_3), 6.22 (s, 2H, 3-H, 5-H), 7.27–7.33 (m, 1H, thiophene 4-H), 8.00 (dd, $J = 6$ and 1.5 Hz, 1H, thiophene 3-H), 8.11 (dd, $J = 6$ and 1.5 Hz, 1H, thiophene 5-H) ppm.

General procedure for the synthesis of 3-benzoyl-4-hydroxy-1,6-dimethyl-2(1H)-pyridones **4a–j** *and 5-benzoyl-6-hydroxy-2,3-diphenyl-4(3H)-pyrimidones* **10a–i**

Method A

To a solution of **1** or **8** (10 mmol) in 50 ml of dry toluene the corresponding acid chloride **2** (12 mmol) and Et_3N (10 mmol) were added. The solution was heated for 5 h under reflux. After cooling to room temperature, 1.36 g KCN (20 mmol), 1.4 ml Et_3N (10 mmol), and catalytic amounts (0.4–0.5 g) of 18-crown-6 were added. The reaction mixture was stirred for 72 h at room temperature. At the end of the reaction, 60 ml of CH_2Cl_2 were added, and the mixture was washed several times with dilute HCl in a separatory funnel. The organic phase was dried over Na_2SO_4, and the solvent was removed by evaporation.

Method B

A mixture of 10 mmol **3a–l** or **9a–m**, 1.4 ml Et_3N (10 mmol), 1.36 g KCN (20 mmol), and catalytic amounts (0.4–0.5 g) of 18-crown-6 in 60 ml of dry toluene was stirred for 48 h at room temperature. After addition of 70 ml CH_2Cl_2 the reaction mixture was washed several times with dilute HCl in a separatory funnel. The organic phase was dried over Na_2SO_4, and the solvent was removed by evaporation.

3-Benzoyl-4-hydroxy-1,6-dimethyl-2(1H)-pyridone (**4a**; $C_{14}H_{13}NO_3$)

Prepared by method A in 31% yield; m.p.: 152–155°C (ethanol); IR: $\nu = 3100$–2840 wb, 1640–1610 s, 1555 m cm^{-1}; ^1H NMR (200 MHz, δ, *DMSO*-d_6): 2.36 (s, 3H, CH_3), 3.32 (s, 3H, NCH_3), 5.97 (s, 1H, 5-H), 7.40–7.52 (m, 3H, aryl-H), 7.60 (dd, $J = 7$ and 1.5 Hz, 2H, aryl-H), 11.45 (s, 1H, OH) ppm.

3-(4-Chlorobenzoyl)-4-hydroxy-1,6-dimethyl-2(1H)-pyridone (**4b**; $C_{14}H_{12}ClNO_3$)

Prepared by method A in 63% and by method B in 57% yield; m.p.: 152–154°C (toluene); IR: $\nu = 1650$ s, 1630 s, 1560 m, 1485 m cm^{-1}; ^1H NMR (200 MHz, δ, *DMSO*-d_6): 2.38 (s, 3H, CH_3), 3.41

(s, 3H, NCH_3), 6.00 (s, 1H, 5-H), 7.54 (d, $J = 8$ Hz, 2H, phenyl 3-H, 5-H), 7.72 (d, $J = 8$ Hz, 2H, phenyl 2-H, 6-H) ppm.

3-(2-Chlorobenzoyl)-4-hydroxy-1,6-dimethyl-2(1H)-pyridone (**4c**; $C_{14}H_{12}ClNO_3$)

Prepared by method A in 62% yield; m.p.: 150–153°C (1-butanol); IR: $\nu = 3200$–2840 w, 1640 s, 1620 s, 1550 m cm^{-1}, ^1H NMR (200 MHz, δ, *DMSO*-d_6): 2.40 (s, 3H, CH_3), 3.25 (s, 3H, NCH_3), 6.10 (s, 1H, 5-H), 7.25–7.46 (m, 4H, aryl-H) ppm.

3-(2-Bromobenzoyl)-4-hydroxy-1,6-dimethyl-2(1H)-pyridone (**4d**; $C_{14}H_{12}BrNO_3$)

Prepared by method A in 54% yield; m.p.: 127–130°C (1-butanol); IR: $\nu = 3120$–2840 wb, 1645 s, 1615 s, 1590 m, 1565 s cm^{-1}; ^1H NMR (200 MHz, δ, *DMSO*-d_6): 2.40 (s, 3H, CH_3), 3.22 (s, 3H, NCH_3), 6.10 (s, 1H, 5-H), 7.20–7.45 (m, 3H, aryl-H), 7.60 (dd, $J = 7$ and 1.5 Hz, 1H, aryl-H) ppm.

3-(4-Methylbenzoyl)-4-hydroxy-1,6-dimethyl-2(1H)-pyridone (**4e**; $C_{15}H_{15}NO_3$)

Prepared by method A in 60% yield; m.p.: 187–190°C (ethanol); IR: $\nu = 3360$–2800 mb, 1660 s, 1605 m, 1590 m, 1555 s cm^{-1}; ^1H NMR (200 MHz, δ, *DMSO*-d_6): 2.37 (s, 6H, $2\times CH_3$), 3.35 (s, 3H, NCH_3), 5.97 (s, 1H, 5-H), 7.28 (d, $J = 8$ Hz, 2H, phenyl 3-H, 5-H), 7.62 (d, $J = 8$ Hz, 2H, phenyl 2-H, 6-H), 11.28 (s, 1H, OH) ppm.

3-(4-Methoxybenzoyl)-4-hydroxy-1,6-dimethyl-2(1H)-pyridone (**4f**; $C_{15}H_{15}NO_4$)

Prepared by method A in 41% and method B 52% yield; m.p.: 194–197°C (ethanol); IR: $\nu = 2980$–2800 w, 1665 s, 1600 s, 1545 m cm^{-1}; ^1H NMR (200 MHz, δ, *DMSO*-d_6): 2.32 (s, 3H, CH_3), 3.35 (s, 3H, NCH_3), 3.83 (s, 3H, OCH_3), 5.95 (s, 1H, 5-H), 7.00 (d, $J = 8$ Hz, 2H, phenyl 3-H, 5-H), 7.71 (d, $J = 8$ Hz, 2H, phenyl 2-H, 6-H), 11.11 (s, 1H, OH) ppm.

3-(2,4-Dichlorobenzoyl)-4-hydroxy-1,6-dimethyl-2(1H)-pyridone (**4g**; $C_{14}H_{11}Cl_2NO_3$)

Prepared by method A in 59% yield; m.p.: 161–164°C (1-butanol); IR: $\nu = 3100$–2920 w, 1665 s, 1610 s, 1560 s cm^{-1}; ^1H NMR (200 MHz, δ, *DMSO*-d_6): 2.40 (s, 3H, CH_3), 3.33 (s, 3H, NCH_3), 6.12 (s, 1H, 5-H), 7.32 (d, $J = 8$ Hz, 1H, aryl-H), 7.48 (dd, $J = 8$ and 2 Hz, 1H, aryl-H), ppm.

3-(2,3-Dichloro-4-methylsulfonylbenzoyl)-4-hydroxy-1,6-dimethyl-2(1H)-pyridone (**4h**; $C_{15}H_{13}Cl_2NO_5S$)

Prepared by method A in 64% yield; m.p.: 195–197°C (ethanol); IR: $\nu = 3140$–2900 w, 1650 s, 1600 s, 1565 s cm^{-1}; ^1H NMR (200 MHz, δ, *DMSO*-d_6): 2.46 (s, 3H, CH_3), 3.30 (s, 3H, SO_2CH_3), 3.54 (s, 3H, NCH_3), 6.28 (s, 1H, 5-H), 7.62 (d, $J = 7$ Hz, 1H, phenyl 5-H), 8.15 (d, $J = 7$ Hz, 1H, phenyl 6-H), 14.00 (s, 1H, OH) ppm.

3-(2-Methylbenzoyl)-4-hydroxy-1,6-dimethyl-2(1H)-pyridone (**4i**; $C_{15}H_{15}NO_3$)

Prepared by method A in 43% yield; m.p.: 135–137°C (1-butanol); IR: $\nu = 2960$–2850 w, 1640 s, 1612 s, 1555 m cm^{-1}; ^1H NMR (200 MHz, δ, *DMSO*-d_6): 2.22 (s, 3H, CH_3), 2.38 (s, 3H, CH_3), 3.28 (s, 3H, NCH_3), 6.08 (s, 1H, 5-H), 7.12–7.37 (m, 4H, aryl-H) ppm.

3-(2-Thienylcarbonyl)-4-hydroxy-1,6-dimethyl-2(1H)-pyridone (**4j**; $C_{12}H_{11}NO_3S$)

Prepared by method A in 53% yield; m.p.: 152–154°C (1-butanol); IR: $\nu = 3090$ w, 1665 s, 1585 s, 1545 m cm^{-1}; ^{1}H NMR (200 MHz, δ, *DMSO*-d_6): 2.34 (s, 3H, CH_3), 3.32 (s, 3H, NCH_3), 5.94 (s, 1H, 5-H), 7.16 (t, $J = 5$ Hz, thiophene 4-H), 7.56 (dd, $J = 6$ and 1.5 Hz, thiophene 3-H), 7.95 (dd, $J = 6$ and 1.5 Hz, 1H, thiophene 5-H), 11.09 (s, 1H, OH) ppm.

1,6-Dimethyl-3-phenylaminomethylene-pyridine-2,4(1H,3H)-dione (**5**; $C_{14}H_{14}N_2O_2$)

A mixture of 2.8 g **1** (20 mmol) with 2.96 g triethyl orthoformiate (20 mmol) and 1.86 g aniline (20 mmol) in 20 ml ethylene glycole was heated under stirring until the formation of ethanol started. The temperature was increased during 20 minutes to 180°C until the formation of ethanol stopped. The reaction mixture was cooled to room temperature and treated with ethanol.

Yield: 2.30 g (48%); m.p.: 175–178°C (ethanol); IR: $\nu = 3100$–2800 w, 1650 s, 1615 s, 1585 s, 1550 m cm^{-1}; ^{1}H NMR (200 MHz, δ, *DMSO*-d_6): 2.25 (s, 3H, CH_3), 3.30 (s, 3H, NCH_3), 5.62 (s, 1H, 5-H), 7.22–7.58 (m, 5H, aryl H), 8.65–8.85 (m, 1H, NH) ppm.

2-(4-Chlorophenyl)-5,6-dimethyl-oxazolo[4,5-c]pyridin-4(5H)-one (**7a**; $C_{14}H_{11}ClN_2O_2$)

A solution of 2.78 g **4b**, 1.39 g $NH_2OH \cdot HCl$ (20 mmol), and 1.68 g $NaHCO_3$ (20 mmol) in 100 ml ethanol/water (3:1) was heated for 30 minutes under reflux. Then the reaction mixture was poured into ice/water, and the precipitate obtained was filtered after standing for 2–3 h. The crude product **6a** was dried overnight and heated next day in 30 ml ethylene glycole for 30 min under reflux. After cooling the product precipitated.

Yield: 1.80 g (33%); m.p.: 262–267°C (ethanol); IR: $\nu = 3100$ w, 2970–2820 w, 1690 s, 1575 m cm^{-1}; ^{1}H NMR (200 MHz, δ, *DMSO*-d_6): 2.50 (s, 3H, CH_3), 3.52 (s, 3H, NCH_3), 6.80 (s, 1H, 7-H), 7.63 (d, $J = 7$ Hz, 2H, phenyl 3-H, 5-H), 8.06 (d, $J = 7$ Hz, 2H, phenyl 2-H, 6-H) ppm.

5,6-Dimethyl-2-(4-methylphenyl)oxazolo[4,5-c]pyridin-4(5H)-one (**7b**; $C_{15}H_{14}N_2O_2$)

From 2.57 g **4e** (10 mmol) according to the preparation of **7a**.

Yield: 1.13 g (44%); m.p.: 250–253°C (ethanol); IR: $\nu = 2940$–2840 w, 1675 s, 1610 w, 1588 m, 1565 s cm^{-1}; ^{1}H NMR (200 MHz, δ, *DMSO*-d_6): 2.40 (s, 3H, CH_3), 2.50 (s, 3H, CH_3), 3.54 (s, 3H, NCH_3), 6.82 (s, 1H, 7-H), 7.40 (d, $J = 8$ Hz, 2H, phenyl 3-H, 5-H), 7.99 (d, $J = 8$ Hz, 2H, phenyl 2-H, 6-H) ppm.

5,6-Dimethyl-2-(4-methoxyphenyl)-oxazolo[4,5-c]pyridin-4(5H)-one (**7c**; $C_{15}H_{14}N_2O_3$)

From 2.73 g **4f** (10 mmol) according to the preparation of **7a**.

Yield: 0.95 g (35%); m.p.: 235–239°C (ethanol); IR: $\nu = 3060$ w, 3000 –2840 w, 1675 s, 1610 m, 1575 m cm^{-1}; ^{1}H NMR (200 MHz, δ, *DMSO*-d_6): 2.50 (s, 3H, CH_3), 3.53 (s, 3H, NCH_3), 3.87 (s, 3H, OCH_3), 6.81 (s, 1H, 7-H), 7.15 (d, $J = 10$ Hz, 2H, phenyl 3-H, 5-H), 8.03 (d, $J = 10$ Hz, 2H, phenyl 2-H, 6-H) ppm.

6-Benzoyloxy-2,3-diphenyl-4(3H)-pyrimidone (**9a**; $C_{23}H_{16}N_2O_3$)

Prepared by method A in 70% and by method B in 57% yield; m.p.: 196–198°C (ethanol); IR: $\nu = 3060$ w, 1750 s, 1685 s, 1590 m, 1530 s cm^{-1}; ^{1}H NMR (200 MHz, δ, *DMSO*-d_6): 6.69 (s, 1H, 3-H), 7.19–7.42 (m, 10H, aryl-H), 7.62–7.86 (m, 3H, aryl-H), 8.16 (dd, $J = 7$ and 1.5 Hz, 2H, aryl-H) ppm.

6-(4-Chlorobenzoyloxy)-2,3-diphenyl-4(3H)-pyrimidone (**9b**; $C_{23}H_{15}ClN_2O_3$)

Prepared by method A in 67% and by method B in 53% yield; m.p.: 147–149°C (ethanol); IR: $\nu = 3100$–3050 w, 1790 m, 1750 s, 1690 s, 1595 s cm^{-1}; ^{1}H NMR (200 MHz, δ, *DMSO*-d_6): 6.58 (s, 1H, 3-H), 7.16–7.38 (m, 10H, aryl-H), 7.68–7.74 (m, 2H, phenyl 3-H, 5-H), 8.09–8.16 (m, 2H, phenyl 2-H, 6-H) ppm.

6-(2-Chlorobenzoyloxy)-2,3-diphenyl-4(3H)-pyrimidone (**9c**; $C_{23}H_{15}ClN_2O_3$)

Prepared by method A in 65% and by method B in 66% yield; m.p.: 164–166°C (ethanol); IR: $\nu = 3070$–3050 w, 1755 s, 1690 s, 1600 m, 1590 m cm^{-1}; ^{1}H NMR (200 MHz, δ, *DMSO*-d_6): 6.60 (s, 1H, 3-H), 7.22–7.40 (m, 10H, aryl-H), 7.54–7.63 (m, 1H, phenyl-H), 7.70–7.76 (m, 2H, phenyl-H), 8.12 (dd, $J = 7$ and 1.5 Hz, 1H, phenyl-H) ppm.

6-(2-Bromobenzoyloxy)-2,3-diphenyl-4(3H)-pyrimidone (**9d**; $C_{23}H_{15}BrN_2O_3$)

Prepared by method A in 44% and by method B in 72% yield; m.p.: 104–108°C (ethanol); IR: $\nu = 3060$–3040 w, 1745 s, 1685 s, 1595 m, 1585 m cm^{-1}; ^{1}H NMR (200 MHz, δ, *DMSO*-d_6): 6.61 (s, 1H, 3-H), 7.20–7.41 (m, 10H, aryl-H), 7.58–7.68 (m, 2H, phenyl-H), 7.84–7.93 (m, 1H, phenyl-H), 8.05–8.15 (m, 1H, phenyl-H) ppm.

6-(4-Chloro-2-nitrobenzoyloxy)-2,3-diphenyl-4(3H)-pyrimidone (**9e**; $C_{23}H_{14}ClN_3O_5$)

Prepared by method A in 84% yield; m.p.: 138–144°C (ethanol); IR: $\nu = 3130$–3010 wb, 1765 s, 1690 s, 1590 m, 1530 s cm^{-1}; ^{1}H NMR (200 MHz, δ, *DMSO*-d_6): 6.58 (s, 1H, 3-H), 7.20–7.42 (m, 10H, aryl-H), 8.03–8.10 (m, 1H, phenyl 5-H), 8.20 (d, $J = 8$ Hz, 1H, phenyl 6-H), 8.40 (d, $J = 1.5$ Hz, 1H, phenyl 3-H) ppm.

6-(4-Methylbenzoyloxy)-2,3-diphenyl-4(3H)-pyrimidone (**9f**; $C_{24}H_{18}N_2O_3$)

Prepared by method B in 72% yield; m.p.: 199–201°C (1-butanol); IR: $\nu = 3100$–2900 wb, 1740 s, 1690 s, 1605 m, 1520 s cm^{-1}; ^{1}H NMR (200 MHz, δ, *DMSO*-d_6): 2.42 (s, 3H, CH_3), 6.58 (s, 1H, 3-H), 7.18–7.40 (m, 10H, aryl-H), 7.45 (d, $J = 8$ Hz, 2H, phenyl 3-H, 5-H), 8.04 (d, $J = 8$ Hz, 2H, phenyl 2-H, 6-H) ppm.

6-(4-Methoxybenzoyloxy)-2,3-diphenyl-4(3H)-pyrimidone (**9g**; $C_{24}H_{18}N_2O_4$)

Prepared by method B in 70% yield; m.p.: 188–190°C (ethanol).

6-(2,4-Dichlorobenzoyloxy)-2,3-diphenyl-4(3H)-pyrimidone (**9h**; $C_{23}H_{14}Cl_2N_2O_3$)

Prepared by method B in 82% yield; m.p.: 154–157°C (ethanol); IR: $\nu = 3060$ w, 1758 s, 1695 s, 1605 m, 1580 m cm^{-1}; ^{1}H NMR (200 MHz, δ, *DMSO*-d_6): 6.61 (s, 1H, 3-H), 7.19–7.42 (m, 10H, aryl-H), 7.70 (dd, $J = 8$ and 1.5 Hz, 1H, phenyl 5-H), 7.92 (d, $J = 2$ Hz, 1H, phenyl 3-H), 8.18 (d, $J = 8$ Hz, 1H, phenyl 6-H) ppm.

6-(2,3-Dichloro-4-methylsulfonylbenzoyloxy)-2,3-diphenyl-4(3H)-pyrimidone (**9i**; $C_{24}H_{16}Cl_2N_2O_5S$)

Prepared by method A in 23% yield; m.p.: 208–210°C (ethanol); IR: $\nu = 3070$ w, 1760 s, 1680 m, 1500 m cm^{-1}; ^{1}H NMR (200 MHz, δ, *DMSO*-d_6): 3.52 (s, 3H, SO_2CH_3), 6.68 (s, 1H, 3-H), 7.20–7.40 (m, 10H, aryl-H), 8.28 (m, 2H, phenyl-H) ppm.

6-(2-Methylbenzoyloxy)-2,3-diphenyl-4(3H)-pyrimidone (**9j**; $C_{24}H_{18}N_2O_3$)

Prepared by method B in 63% yield; m.p.: 143–145°C (1-butanol); IR: $\nu = 3100$–2880 w, 1750 s, 1680 m, 1590 m, 1515 s cm^{-1}; ^{1}H NMR (200 MHz, δ, *DMSO*-d_6): 2.64 (s, 3H, CH_3), 6.60 (s, 1H, 3-H), 7.20–7.70 (m, 13H, aryl-H), 8.10 (dd, $J = 7$ and 1.5 Hz, 1H, phenyl H) ppm.

6-(2-Methyl-3-methoxy-4-methylsulfonylbenzoyloxy)-2,3-diphenyl-4(3H)-pyrimidone (**9k**; $C_{26}H_{22}N_2O_6S$)

Prepared by method A in 51% yield; m.p.: 174–179°C (ethanol).

6-(2-Thienylcarbonyloxy)-2,3-diphenyl-4(3H)-pyrimidone (**9l**; $C_{21}H_{14}N_2O_3S$)

Prepared by method A in 63% yield; m.p.: 168–172°C (ethanol); IR: $\nu = 3070$ w, 1730 s, 1685 s, 1510 s cm^{-1}; ^{1}H NMR (200 MHz, δ, *DMSO*-d_6): 6.58 (s, 1H, 3-H), 7.20–7.40 (m, 11H, 10 aryl-H, thiophene 4-H), 8.08 (dd, $J = 6$ and 1 Hz, 1H, thiophene 3-H), 8.19 (dd, $J = 6$ and 1 Hz, 1H, thiophene 5-H) ppm.

6-(3-Pyridylcarbonyloxy)-2,3-diphenyl-4(3H)-pyrimidone (**9m**; $C_{22}H_{15}N_3O_3$)

Prepared by method B in 32% yield; m.p.: 150–160°C (toluene); IR: $\nu = 3060$ w, 1755 s, 1680 s, 1590 s, 1545 s cm^{-1}; ^{1}H NMR (200 MHz, δ, *DMSO*-d_6): 6.53 (s, 1H, 3-H), 7.19–7.42 (m, 10H, 10 aryl-H), 7.65–7.75 (m, 1H, pyridine 5-H), 8.50 (m, 1H, pyridine 4-H), 8.95 (dd, $J = 7$ and 1.5 Hz, pyridine 6-H), 9.28 (d, $J = 1.5$ Hz, pyridine 2-H) ppm.

5-Benzoyl-6-hydroxy-2,3-diphenyl-4(3H)-pyrimidone (**10a**; $C_{23}H_{16}N_2O_3$)

Prepared by method A in 82% yield; m.p.: 228–230°C (ethanol).

5-(4-Chlorobenzoyl)-6-hydroxy-2,3-diphenyl-4(3H)-pyrimidone (**10b**; $C_{23}H_{15}ClN_2O_3$)

Prepared by method A in 38% and by method B in 52% yield; m.p.: 198–201°C (ethanol); IR: $\nu = 3060$ w, 1700 s, 1590–1490 sb, 1450 m cm^{-1}; ^{1}H NMR (200 MHz, δ, *DMSO*-d_6): 7.20–7.48 (m, 10H, aryl-H), 7.57 (d, $J = 8$ Hz, 2H, phenyl 3-H, 5-H), 7.92 (d, $J = 8$ Hz, 2H, phenyl 2-H, 6-H) ppm.

5-(2-Chlorobenzoyl)-6-hydroxy-2,3-diphenyl-4(3H)-pyrimidone (**10c**; $C_{23}H_{15}ClN_2O_3$)

Prepared by method A in 74% yield; m.p.: 167–169°C (ethanol); IR: $\nu = 3060$ w, 1700 s, 1560 s, 1525 s, 1490 m cm^{-1}; ^{1}H NMR (200 MHz, δ, *DMSO*-d_6): 7.22–7.50 (m, 14H, aryl-H) ppm.

5-(2-Bromobenzoyl)-6-hydroxy-2,3-diphenyl-4(3H)-pyrimidone (**10d**; $C_{23}H_{15}BrN_2O_3$)

Prepared by method A in 78% yield; m.p.: 185–188°C (ethanol); IR: $\nu = 3060$ w, 1705 s, 1585 s, 1565 s, 1515 s cm^{-1}; ^{1}H NMR (200 MHz, δ, *DMSO*-d_6): 7.18–7.47 (m, 13H, aryl-H), 7.58 (d, $J = 7$ Hz, 1H, aryl-H) ppm.

5-(4-Chloro-2-nitrobenzoyl)-6-hydroxy-2,3-diphenyl-4(3H)-pyrimidone (**10e**; $C_{23}H_{14}ClN_3O_5$)

Prepared by method A in 72% and by method B in 66% yield; m.p.: 202–204°C (toluene); IR: $\nu = 3120$–2840 wb, 1690 s, 1590 m, 1560 m, 1525 s cm^{-1}; ^{1}H NMR (200 MHz, δ, *DMSO*-d_6): 7.22–

7.51 (m, 11H, aryl-H, phenyl 5-H), 7.87 (dd, $J = 7$ and 1.5 Hz, 1H, phenyl 6-H), 8.18 (d, $J = 1.5$ Hz, 1H, phenyl 3-H) ppm.

5-(4-Methylbenzoyl)-6-hydroxy-2,3-diphenyl-4(3H)-pyrimidone (**10f**; $C_{24}H_{18}N_2O_3$)

Prepared by method A in 65% and by method B in 66% yield; m.p.: 218–221°C (1-butanol); IR: $\nu = 3050$ w, 1705 s, 1590 s, 1450 m cm^{-1}; ^{1}H NMR (200 MHz, δ, *DMSO*-d_6): 2.41 (s, 3H, CH_3), 7.23–7.50 (m, 12H, aryl-H), 7.88 (d, $J = 8$ Hz, 2H, phenyl 2-H, 6-H) ppm.

5-(4-Methoxybenzoyl)-6-hydroxy-2,3-diphenyl-4(3H)-pyrimidone (**10g**; $C_{24}H_{18}N_2O_4$)

Prepared by method A in 50% yield; m.p.: 180–184°C (1-butanol).

5-(2,4-Dichlorobenzoyl)-6-hydroxy-2,3-diphenyl-4(3H)-pyrimidone (**10h**; $C_{23}H_{14}Cl_2N_2O_3$)

Prepared by method A in 57% yield; m.p.: 153–156°C (1-butanol); IR: $\nu = 1710$ s, 1585 s, 1565–1525 sb cm^{-1}; ^{1}H NMR (200 MHz, δ, *DMSO*-d_6): 7.22–7.52 (m, 12H, aryl-H), 7.60 (d, $J = 2$ Hz, 1H, phenyl 3-H) ppm.

5-(2-Thienylcarbonyl)-6-hydroxy-2,3-diphenyl-4(3H)-pyrimidone (**10i**; $C_{21}H_{14}N_2O_3S$)

Prepared by method A in 56% yield; m.p.: 235–238°C (toluene); IR: $\nu = 3080$ w, 1680 s, 1550 s, 1520 m cm^{-1}; ^{1}H NMR (200 MHz, δ, *DMSO*-d_6): 7.20–7.50 (m, 11H, aryl-H, thiophene 4-H), 7.90 (dd, $J = 6$ and 1.5 Hz, 1H, thiophene 3-H), 8.02 (dd, $J = 6$ and 1.5 Hz, 1H, thiophene 5-H) ppm.

5-Benzoyloxy-2-methyl-6-phenyl-3(2H)-pyridazinone (**12a**; $C_{18}H_{14}N_2O_3$)

Prepared by method B in 78% yield; m.p.: 147–150°C (ethanol); IR: $\nu = 1750$ s, 1670 s, 1610 w, 1595 w cm^{-1}; ^{1}H NMR (200 MHz, δ, *DMSO*-d_6): 3.78 (s, 3H, NCH_3), 7.24 (s, 1H, 5-H), 7.38–7.43 (m, 3H, aryl-H), 7.54–7.80 (m, 5H, aryl-H), 8.02 (d, $J = 8$ Hz, 2H, aryl-H) ppm.

5-(4-Chlorobenzoyloxy)-2-methyl-6-phenyl-3(2H)-pyridazinone (**12b**; $C_{18}H_{13}ClN_2O_3$)

Prepared by method B in 78% yield; m.p.: 125–126°C (ethanol); IR: $\nu = 3070$ w, 1755 s, 1660 s, 1590 m cm^{-1}; ^{1}H NMR (200 MHz, δ, *DMSO*-d_6): 3.78 (s, 3H, NCH_3), 7.25 (s, 1H, 5-H), 7.35–7.45 (m, 3H, aryl-H), 7.58–7.71 (m, 4H, aryl-H), 7.96–8.20 (m, 2H, aryl-H) ppm.

5-(4-Methoxybenzolyoxy)-2-methyl-6-phenyl-3(2H)-pyridazinone (**12c**; $C_{19}H_{16}N_2O_4$)

Prepared by method B in 83% yield; m.p.: 163–165°C (toluene); IR: $\nu = 1740$ s, 1670 s, 1605 m, 1510 w cm^{-1}; ^{1}H NMR (200 MHz, δ, *DMSO*-d_6): 3.78 (s, 3H, NCH_3), 3.87 (s, 3H, OCH_3), 7.08 (d, $J = 8$ Hz, 2H, phenyl 3-H, 5-H), 7.20 (s, 1H, 5-H), 7.38–7.44 (m, 3H, aryl-H), 7.60–7.68 (m, 2H, aryl-H), 7.96 (d, $J = 8$ Hz, 2H, phenyl 2-H, 6-H) ppm.

5-Benzoyloxy-3-chloro-6-phenyl-pyridazine (**15a**; $C_{17}H_{11}ClN_2O_2$)

Prepared by method B in 78% yield; m.p.: 114–117°C (toluene); IR: $\nu = 3050$ w, 1755 s, 1600 m, 1580 w cm^{-1}; ^{1}H NMR (200 MHz, δ, *DMSO*-d_6): 7.47–7.68 (m, 5H, aryl-H), 7.74–7.88 (m, 3H, aryl-H), 8.06 (dd, $J = 7$ and 1.5 Hz, 2H, aryl-H), 8.38 (s, 1H, 4-H) ppm.

3-Chloro-5-(4-chlorobenzoyloxy)-6-phenyl-pyridazine (**15b**; $C_{17}H_{10}Cl_2N_2O_2$)

Prepared by method B in 75% yield; m.p.: 135–137°C (toluene); IR: $\nu = 3150$ w, 1755 s, 1595 m, 1558 m cm^{-1}; ^{1}H NMR (200 MHz, δ, *DMSO*-d$_6$): 7.44–7.55 (m, 3H, aryl-H), 7.68 (d, $J = 8$ Hz, 2H, phenyl 3-H, 5-H), 7.80–7.90 (m, 2H, aryl-H), 8.06 (d, $J = 8$ Hz, 2H, phenyl 2-H, 6-H), 8.38 (s, 1H, 4-H) ppm.

3-Chloro-5-(4-methoxybenzoyloxy)-6-phenyl-pyridazine (**15c**; $C_{18}H_{13}ClN_2O_3$)

Prepared by method B in 79% yield; m.p.: 151–154°C (toluene); IR: $\nu = 3160$–2980 wb, 1740 s, 1610 s, 1580 w cm^{-1}; ^{1}H NMR (200 MHz, δ, *DMSO*-d$_6$): 3.88 (s, 3H, OCH_3), 7.12 (d, $J = 8$ Hz, 2H, phenyl 3-H, 5-H), 7.46–7.54 (m, 3H, aryl-H), 7.80–7.88 (m, 2H, aryl-H), 8.01 (d, $J = 8$ Hz, 2H, phenyl 2-H, 6-H), 8.34 (s, 1H, 4-H) ppm.

4-Benzoyl-3-cyano-5-hydroxy-6-phenyl-pyridazine (**16**; $C_{18}H_{11}N_3O_2$)

To a solution of 2.06 g **11** (10 mmol) in 60 ml of dry toluene, 1.4 ml benzoylchloride (12 mmol) and 1.4 ml Et_3N (10 mmol) were added. The solution was heated for 6 h under reflux. After cooling to room temperature, 1.3 g KCN (20 mmol), 1.4 ml Et_3N (10 mmol), and catalytic amounts (0.4–0.5 g) of 18-crown-6 were added. The reaction mixture was stirred for 72 h at room temperature. At the end of the reaction, 80 ml of CH_2Cl_2 were added, and the mixture was washed several times with dilute HCl in a separatory funnel. **16** precipitated from the aqueous solution during drying the organic phase over Na_2SO_4. Removing the solvent by evaporation yielded the starting material **14**.

Yield of **16**: 0.56 g (19%); m.p.: 209–212°C (ethanol); IR: $\nu = 3320$–3170 m, 3060 w, 2240 s, 1690 s, 1615 m cm^{-1}; ^{1}H NMR (200 MHz, δ, *DMSO*-d$_6$): 7.56–7.76 (m, 6H, aryl-H), 7.93–8.12 (m, 4H, aryl-H), 12.38 (s, 1H, OH) ppm.

General procedure for the synthesis of 2-benzoyl-5-benzoyloxy-1-phenyl-3(2H)-pyrazolones **18a–e**

To a solution of 5-hydroxy-1-phenyl-3(2*H*)-pyrazolone (**6**, 10 mmol) in 70 ml of dry toluene, the corresponding acid chloride **2** (22 mmol) and Et_3N (20 mmol) were added. The solution was heated for 7 h under reflux. After cooling to room temperature, 100 ml CH_2Cl_2 were added, and the mixture was washed several times with dilute HCl in a separatory funnel. The organic phase was dried over Na_2SO_4, and the solvent was removed by evaporation.

2-Benzoyl-5-benzoyloxy-1-phenyl-3(2H)-pyrazolone (**18a**; $C_{23}H_{16}N_2O_4$)

From 1.76 g **6** and 2.6 ml benzoylchloride; yield: 53%; m.p.: 110–111°C (ethanol); IR: $\nu = 1765$ s, 1748 s, 1600 m, 1590 m cm^{-1}; ^{1}H NMR (200 MHz, δ, *DMSO*-d$_6$): 6.65 (s, 1H, 4-H), 7.38–7.85 (m, 11H, aryl-H), 8.08–8.23 (m, 4H, aryl-H) ppm.

2-(4-Chlorobenzoyl)-5-(4-chlorobenzoyloxy)-1-phenyl-3(2H)-pyrazolone (**18b**; $C_{23}H_{14}Cl_2N_2O_4$)

From 1.76 g **6** and 3.0 ml 4-chlorobenzoylchloride; yield: 66%; m.p.: 168–170°C (ethanol); IR: $\nu = 1770$ w, 1760 m, 1745 s, 1595 m cm^{-1}; ^{1}H NMR (200 MHz, δ, *DMSO*-d$_6$): 6.65 (s, 1H, 4-H), 7.38–7.78 (m, 9H, aryl-H), 8.05–8.22 (m, 4H, aryl-H) ppm.

2-(2-Chlorobenzoyl)-5-(2-chlorobenzoyloxy)-1-phenyl-3(2H)-pyrazolone (**18c**; $C_{23}H_{14}Cl_2N_2O_4$)

From 1.76 g **6** and 2.9 ml 2-chlorobenzoylchloride; yield: 56%; m.p.: 105–107°C (ethanol); IR: $\nu = 1775$ s, 1590 m, 1560 m, 1505 m cm^{-1}; ^{1}H NMR (200 MHz, δ, *DMSO*-d$_6$): 6.67 (s, 1H, 4-H), 7.37–7.74 (m, 11H, aryl-H), 8.11 (t, $J = 7$ Hz, 2H, aryl-H) ppm.

2-(4-Methylbenzoyl)-5-(4-methylbenzoyloxy)-1-phenyl-3(2H)-pyrazolone (**18d**; $C_{25}H_{20}N_2O_4$)

From 1.76 g **6** and 3.0 ml 4-methylbenzoylchoride; yield: 61%; m.p.: 181–185°C (toluene); IR: $\nu = 3170$ w, 1750 s, 1738 s, 1615 m, 1600 m cm^{-1}; ^{1}H NMR (200 MHz, δ, *DMSO*-d_6): 2.49 (m, 6H, 2 CH_3), 6.63 (s, 1H, 4-H), 7.42–7.77 (m, 9H, aryl-H), 8.00–8.15 (m, 4H, aryl-H) ppm.

2-(2,4-Dichlorobenzoyl)-5-(2,4-dichlorobenzoyloxy)-1-phenyl-3(2H)-pyrazolone (**18e**; $C_{23}H_{12}Cl_4N_2O_4$)

From 1.76 g **6** and 3.08 ml 2,4-dichlorobenzoylchloride; yield: 52%; m.p.: 148°C (ethanol); ^{1}H NMR (200 MHz, δ, *DMSO*-d_6): 6.63 (s, 1H, 4-H), 7.27–7.62 (m, 9H, aryl-H), 7.88 (d, $J = 8$ Hz, 1H, aryl-H), 8.12 (d, $J = 8$ Hz, 1H, aryl-H) ppm.

2,4-Di-(4-chlorobenzoyl)-5-hydroxy-1-phenyl-3(2H)-pyrazolone (**19a**; $C_{23}H_{14}Cl_2N_2O_4$)

A mixture of 2.26 g **18b** (5 mmol), 0.7 ml Et_3N (5 mmol), 0.68 g KCN (10 mmol), and catalytic amounts (0.3–0.4 g) of 18-crown-6 in 50 ml of dry toluene was stirred for 48 h at room temperature. After addition of 70 ml CH_2Cl_2, the reaction mixture was washed several times with dilute HCl in a separatory funnel. The organic phase was dried over Na_2SO_4, and the solvent was removed by evaporation.

Yield: 1.25 g (55%); m.p.: 167–170°C (ethanol); IR: $\nu = 1758$ s, 1612 m, 1595 s, 1560 s cm^{-1}; ^{1}H NMR (200 MHz, δ, *DMSO*-d_6): 7.28–7.95 (m, 13H, aryl-H) ppm.

2,4-Di-(4-methylbenzoyl)-5-hydorxy-1-phenyl-3(2H)-pyrazolone (**19b**; $C_{25}H_{20}N_2O_4$)

Form 1.24 g **18d** (3 mmol) according to the preparation of **19a**.

Yield: 1.10 g (89%); m.p.: 163–167°C (ethanol); IR: $\nu = 1748$ s, 1610 s, 1560 s, 1455 m cm^{-1}; ^{1}H NMR (200 MHz, δ, *DMSO*-d_6): 2.18 (s, 3H, CH_3), 2.42 (s, 3H, CH_3), 7.13 (d, $J = 8$ Hz, 2H, aryl-H), 7.30–7.44 (m, 3H, aryl-H), 7.50–7.63 (m, 4H, aryl-H), 7.70–7.82 (m, 4H, aryl-H) ppm.

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Received April 8, 1998. Accepted (revised) May 4, 1998