Diastereoselective and Efficient Synthesis of Indeno[2″,1″:4′,5′]furo[3′,2′:5,6]pyrido[2,3-*d*]pyrimidine-2,4,6(1*H*,3*H*)-trione and 6-(2,3-Dihydro-2-hydroxy-1,3-dioxo-1*H*-inden-2-yl)-5,8-dihydropyrido[2,3-*d*]pyrimidine-2,4,7(1*H*,3*H*,6*H*)-trione Derivatives

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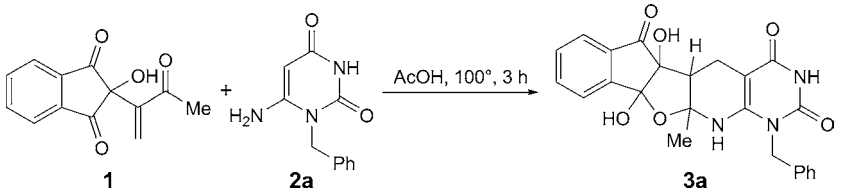
A diastereoselective synthesis of some new *N*-containing heterocyclic compounds, indeno-[2″,1″:4′,5′]furo[3′,2′:5,6]pyrido[2,3-*d*]pyrimidine-2,4,6(1*H*,3*H*)-trione derivatives, is presented. Products were obtained in good to excellent yields by the reaction of amino(thio)uracils with 2-hydroxy-2-(3-oxobut-1-en-2-yl)-2*H*-indene-1,3-dione in AcOH under reflux conditions. Also, a simple and efficient method was introduced for the synthesis of 6-(2,3-dihydro-2-hydroxy-1,3-dioxo-1*H*-inden-2-yl)-5,8-dihydropyrido[2,3-*d*]pyrimidine-2,4,7(1*H*,3*H*,6*H*)-triones *via* the reaction of amino(thio)uracils and methyl 2-(2,3-dihydro-2-hydroxy-1,3-dioxo-1*H*-inden-2-yl)acrylate. The simple procedure and easy work-up, high yields, short reaction times, and diastereoselectivity of the reaction are salient features of this method. The structural assignments are supported by ^{1}H- and ^{13}C-NMR, and X-ray crystallography data.

Introduction. – Pyridopyrimidines are among the *N*-heterocyclic compounds which are of high importance due to their biological and pharmaceutical activities, such as anti-tumor [1][2], heart stimulus, blood pressure reducer [3][4], anti-bronchitis [5], anti-allergic [6], anti-bacterial activities, and they act as preventive of adenosine kinase [7][8] as well. On the other hand, the fused rings of pyrimidine with different heterocyclic compounds, among which are furo[2,3-*d*]pyrimidines, possess also numerous biological properties. Some furo[2,3-*d*]pyrimidine derivatives have been found to have antibacterial [9], bactericidal [10], coronary dilatory, antihypertensive, and muscle relaxant activities [11]. Therefore, the design and the synthesis of fused multi-heterocyclic compounds including pyridopyrimidine and a furan skeleton can be important.

In continuation of our interest to develop more efficient processes for the synthesis of potentially biologically important heterocycles [12], herein, we describe a novel and diastereoselective approach for the synthesis of some new indeno[2″,1″:4′,5′]furo-[3′,2′:5,6]pyrido[2,3-*d*]pyrimidinone derivatives.

Results and Discussion. – We initially utilized 6-aminouracil **2a** (1 mmol) and 2-hydroxy-2-(3-oxobut-1-en-2-yl)-2*H*-inden-1,3-dione (**1**, 1 mmol) as the substrates in AcOH under a variety of temperatures to examine the reaction outcome. To our

Scheme 1. *The Synthesis of 1-Benzyl-5,5a,5b,10b,11a,12-hexahydro-5b,10b-dihydroxy-11a-methyl-2*H*-indeno[2″,1″:4′,5′]furo[3′,2′:5,6]pyrido[2,3-*d*]pyrimidine-2,4,6(1*H*,3*H*)-trione* (**3a**)



delight, we found that at 100°, the reaction was complete after 3 h, and compound **3a** was obtained in 95% yield (*Scheme 1*). However, further increase of the temperature did not improve the yield of product **3a**, and when the reaction was carried out at temperatures lower than 90°, the reaction was not complete even after 8 h.

The molecular structure of the indeno[2″,1″:4′,5′]furo[3′,2′:5,6]pyrido[2,3-*d*]pyrimidinone derivative **3a** was established from its elemental analysis, IR, ^{1}H- and ^{13}C-NMR spectra. The IR spectrum of **3a** showed absorption bands due to the OH, NH, and C=O stretching frequencies at 3454, 3247, and 1724 cm^{-1}, respectively. The ^{1}H-NMR spectrum of **3a** in (D_6)DMSO exhibited a *singlet* at 1.48 ppm due to the Me group of the furan moiety. CH and diastereotopic CH_2 H-atoms of the pyridine moiety appeared as a *dd* at δ(H) 2.22 and two *d* at δ(H) 2.54 and 2.88. Two dependent *doublet*s at δ(H) 3.96 and 4.43 were readily recognized as arising from benzylic CH_2 groups. The aryl H-atoms displayed characteristic signals in the aromatic region of the spectrum. The ^{1}H-NMR spectrum of **3a** also exhibited three sharp *singlet*s at δ(H) 6.16, 6.62, and 7.04, which arise from the OH and pyridine NH, however, the NH H-atom of the pyrimidine resonated as a sharp *singlet* at δ(H) 10.45. The ^{1}H-decoupled ^{13}C-NMR spectrum of **3a** showed 22 distinct resonances in agreement with the assigned structure.

We studied the X-ray crystal-structure of **3a**, in order to confirm the proposed structure and to find the correct relative configuration. The ORTEP diagram of the crystal structure of **3a** (*Fig.*) revealed that the H-atom, the Me and the two OH substituents attached at the the furan moiety have *cis* orientation. Although there exists the possibility of eight diastereoisomers of this product, only one pair of enantiomers was formed. This means that the reaction occured with excellent stereoselectivity.

After the identification and confirmation of the structure of **3a**, and in order to demonstrate the synthetic versatility of this method, more amino(thio)uracil derivatives were subjected to this reaction, and the expected products were obtained in high yields (*Table 1*). Worthy to note is that all of the reactions gave clean products, so that after work-up, no additional purification of the products was required.

With respect to well-known *Michael* additions of enaminones to α,β-unsaturated carbonyl compounds [13] and having the experiences of the reaction of ninhydrin with 1,3-diketones [14] on hands, a reasonable mechanism for the formation of compounds **3** is proposed in *Scheme 2*. Acid catalyzed addition reaction of aminouracil **2** to 2-(3-oxobut-1-en-2-yl)-1*H*-indene **1**, followed by an intramolecular cyclization, gives the intermediate **A**, and, after deprotonation, yields (indenofuran-3-yl)methylpyrimidinone **4**. In the presence of an acid catalyst, intermediate **4** undergoes a second intramolecular cyclization to form the final product **3** *via* intermediate **C**. In order to

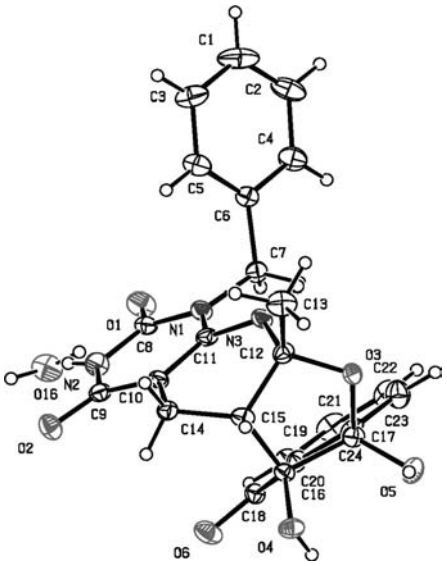
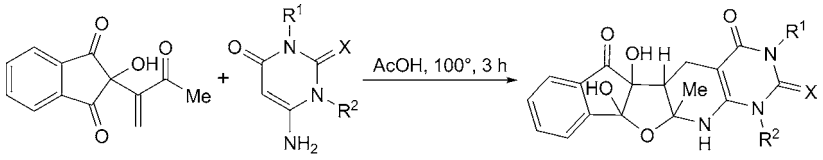


Figure. *ORTEP Diagram for compound* **3a**

Table 1. *The Structure and Yields of the Isolated Indeno[2'',1'': 4',5']furo[3',2': 5,6]pyrido[2,3-*d*]pyrimidinones* **3a** – **3e**



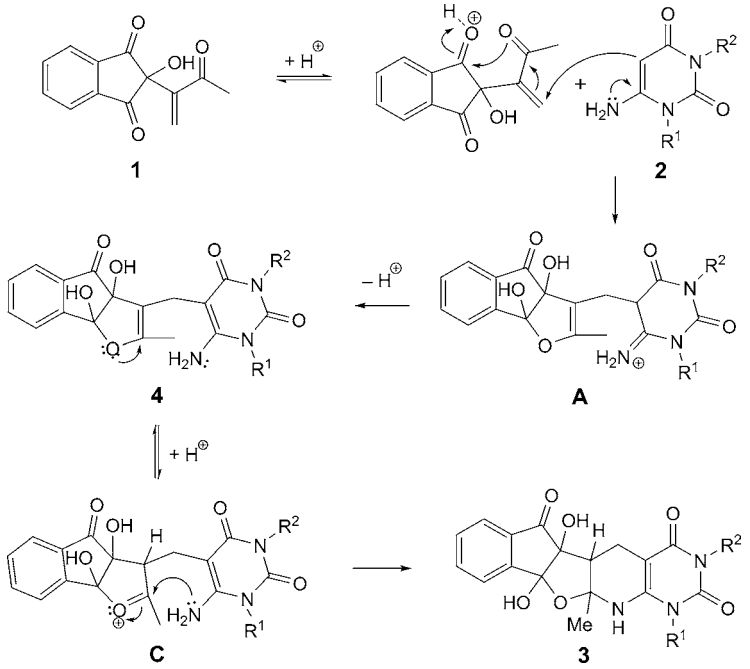
1 **2** **3**

Entry	X	R^1	R^2	Product	Yield [%]
1	O	H	Ph – CH_2	**3a**	95
2	O	Me	Me	**3b**	95
3	O	H	Ph	**3c**	90
4	S	H	Ph	**3d**	90
5	S	H	Me	**3e**	85

support the proposed mechanism, we tried to prepare and extract intermediate **4** from the mixture. Surprisingly, when the typical procedure was carried out for the synthesis of compound **3b** at 50°, 6-amino-5-[(4,8b-dihydro-3a,8b-dihydroxy-2-methyl-4-oxo-3a*H*-indeno[1,2-*b*]furan-3-yl)methyl]-1,3-dimethylpyrimidine-2,4(1*H*,3*H*)-dione (**4b**) was isolated and identified on the basis of its ^{1}H- and ^{13}C-NMR data. It is worth mentioning that we were not able to separate the other derivatives of type **4**. However, separation of **4b** is a clear sign for the reasonability of our proposed mechanism.

In addition, we discovered that, when methyl 2-(2,3-dihydro-2-hydroxy-1,3-dioxo-1*H*-inden-2-yl)acrylate (**5**) [15] was treated with aminouracil **2b** under the above-

Scheme 2. *The Proposed Mechanism for the Formation of Compounds* **3**



mentioned reaction conditions, a *Michael* addition, followed by condensation reaction occurred, which lead to 1,3-indanedione-substituted pyrido[2,3-*d*]pyrimidinone **6a** (*Scheme 3*). At 110°, the best results were obtained. Furthermore, examination of the reaction of the ethyl derivative of **5** with **2b** gave the same product **6a**.

The scope of the reaction was explored by varying the amino uracil component **2**. As summarized in *Table 2*, using methyl 2-(2,3-dihydro-2-hydroxy-1,3-dioxo-1*H*-inden-2-yl)acrylate (**5**) as a condensation partner, a number of amino(thio)uracils **2** were tested. We were pleased that most of them worked well to afford the corresponding product **6** in high to excellent yields.

In the view of mechanism, a *Michael* addition, followed by a simple acid-catalyzed condensation reaction along with the release of MeOH, occurs between **5** and amino(thio)uracils **2** (*Scheme 4*).

Scheme 3. *Synthesis of 1,3-Indanedione-Substituted Pyrido[2,3-*d*]pyrimidinone* **6a**

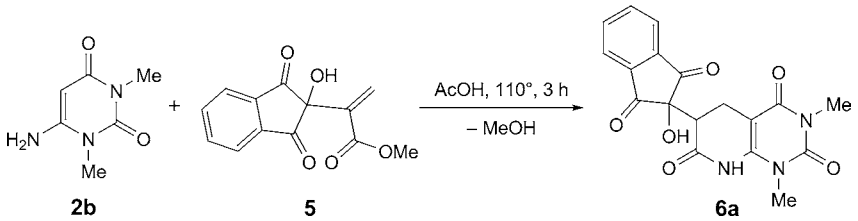
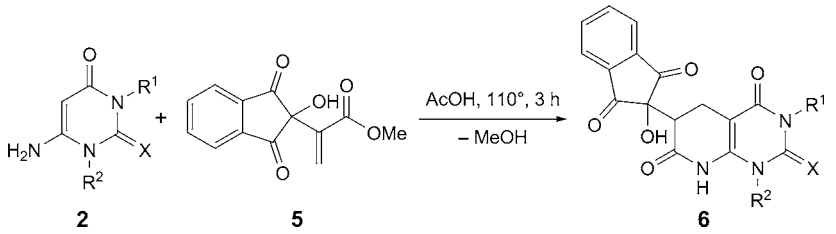


Table 2. *Results for the Synthesis of 6-(2-Hydroxy-1,3-dioxoinden-2-yl)pyrido[2,3-*d*]pyrimidinones* **6a**–**6e**

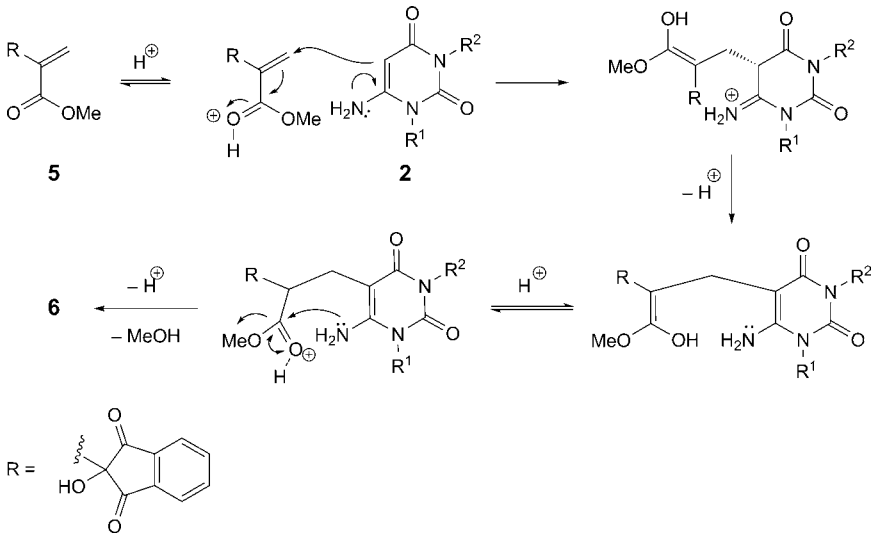


2 **5** **6**

Entry	X	R^1	R^2	Product	Yield [%][a])
1	O	Me	Me	**6a**	95
2	O	H	Ph	**6b**	85
3	S	H	Me	**6c**	90
4	S	Me	Me	**6d**	95
5	O	H	Me	**6e**	90

[a]) Yields of isolated products.

Scheme 4. *The Proposed Mechanism for the Formation of the 6-(2,3-Dihydro-2-hydroxy-1,3-dioxo-1*H*-inden-2-yl)-5,8-dihydropyrido[2,3-*d*]pyrimidinones* **6a**–**6e**



Conclusions. – In summary, a novel, efficient, and highly stereoselective method for the preparation of some new indeno[2″,1″:4′,5′]furo[3′,2′:5,6]pyrido[2,3-*d*]pyrimidinone derivatives through the condensation reaction of amino(thio)uracils with 2-hydroxy-2-(3-oxobut-1-en-2-yl)-2*H*-indene-1,3-dions is described. Furthermore, expansion of the reaction to methyl 2-(2,3-dihydro-2-hydroxy-1,3-dioxo-1*H*-inden-2-yl)acrylate as a replacement for of 2-hydroxy-2-(3-oxobut-1-en-2-yl)-2*H*-indene-1,3-

dions resulted in an efficient synthesis of 6-(2-hydroxy-1,3-dioxoinden-2-yl)pyrido[2,3-*d*]pyrimidinone derivatives. This methods includes some important aspects like high efficiency, simple purification, low reaction times, and high selectivity, and can be a convenient and effective procedure for the synthesis of a wide range of novel drug-like indeno[2″,1″:4′,5′]furo[3′,2′:5,6]pyrido[2,3-*d*]pyrimidinones and 1,3-indanedione-substituted pyrido[2,3-*d*]pyrimidinones.

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Experimental Part

General Remarks. The reagents and solvents used in this work were obtained from *Merck* and *Aldrich* companies and used without further purification. The reaction monitoring was accomplished by TLC on silica gel *PolyGram SILG/UV254* plates. M.p.: *Electrothermal 9100* apparatus. IR Spectra: *Jasco IR-460 Plus* spectrometer. ^{1}H-NMR Spectra: at 500.1 and 400.2 MHz with *Bruker Avance DRX-500* and *-400* NMR spectrometer, and the chemical shifts were reported in ppm relative to TMS as internal standard; the coupling constants, *J*, are reported in Hz. ^{13}C-NMR Spectra: at 125.7 and 100.6 MHz and referenced to TMS as internal standard. All CHNS data were obtained using a *Perkin-Elmer 240C* elemental analyzer, in %.

General Procedure for the Synthesis of the Compounds **3a**–**3e** *and* **6a**–**6e**. To a stirred soln. of 2-hydroxy-2-(3-oxobut-1-en-2-yl)-2*H*-indene-1,3-dione (**1**, 1 mmol, 246 mg) in glacial AcOH (2 ml) was added a 6-aminouracil derivative **2a**–**2e** (1 mmol, 155 mg) at r.t., and the mixture was stirred at 100° for 3 h. Then, the mixture was cooled to r.t. and warm H_2O (70°, 10 ml) was added. The mixture was finally filtered, and the filtrate was washed with warm H_2O (70°, 3 × 5 ml), followed by AcOEt (2 × 3 ml) and subsequent drying under vacuum, which gave the pure products **3a**–**3e**.

For the synthesis of the 6-(2-hydroxy-1,3-dioxo-2-inden-1*H*-yl)pyrido[2,3-*d*]pyrimidinones **6a**–**6e**, a slightly modified procedure was employed, which utilized methyl 2-(2,3-dihydro-2-hydroxy-1,3-dioxo-1*H*-inden-2-yl)acrylate (**5**) as the reactant, and the reaction temperature was increased to 110°.

*1-Benzyl-5,5a,5b,10b,11a,12-hexahydro-5b,10b-dihydroxy-11a-methyl-2*H*-indeno[2″,1″:4′,5′]furo[3′,2′:5,6]pyrido[2,3-*d*]pyrimidine-2,4,6(1*H*,3*H*)-trione* (**3a**). White powder. Yield 95%. M.p. 153° (dec.). IR (KBr): 3454, 3247, 1724, 1638. ^{1}H-NMR ((D$_6$)DMSO, 400 MHz): 1.48 (*s*, Me); 2.22 (*dd*, *J* = 16.4, 6.4, CH); 2.54 (*d*, *J* = 4.4, CH); 2.88 (*d*, *J* = 16.4, CH); 3.96 (*d*, *J* = 17.2, 1 H of CH_2–Ph); 4.43 (*d*, *J* = 17.2, 1 H of CH_2–Ph); 6.16 (*s*, 1 H, NH or OH); 6.62 (*s*, 1 H, NH or OH); 6.87 (*d*, *J* = 7.2, 2 arom. H); 7.04 (*s*, 1 H, NH or OH); 7.16–7.82 (*m*, 7 arom. H); 10.45 (*s*, 1 H, NH). ^{13}C-NMR ((D$_6$)DMSO, 100 MHz): 16.6; 28.0; 53.2; 54.8; 82.9; 84.4; 88.7; 105.5; 122.8; 126.1; 128.2; 128.9; 131.0; 131.5; 134.0; 135.1; 136.6; 146.4; 150.8; 154.1; 161.3; 200.9. Anal. calc. for $C_{24}H_{21}N_3O_6$ (447.44): C 64.42, H 4.73, N 9.39; found: C 64.30, H 4.61, N 9.28.

*5,5a,5b,10b,11a,12-Hexahydro-5b,10b-dihydroxy-1,3,11a-trimethyl-2*H*-indeno[2″,1″:4′,5′]furo[3′,2′:5,6]pyrido[2,3-*d*]pyrimidine-2,4,6(1*H*,3*H*)-trione* (**3b**). White powder. M.p. 179° (dec.). IR (KBr): 3221, 1718, 1696. ^{1}H-NMR ((D$_6$)DMSO, 400 MHz): 1.53 (*s*, Me); 2.23 (*dd*, *J* = 16.0, 6.0, CH); 2.37 (*s*, Me); 2.60–2.64 (*m*, CH); 2.89–2.93 (*m*, CH); 3.03 (*s*, Me); 6.16 (*s*, 1 H, NH or OH); 6.56 (*s*, 1 H, NH or OH); 6.86 (*s*, 1 H, NH or OH); 7.19 (*d*, *J* = 7.8, 1 arom. H); 7.41 (*t*, *J* = 8.1, 1 arom. H); 7.70–7.85 (*m*, 2 arom. H). ^{13}C-NMR ((D$_6$)DMSO,100 MHz): 16.4; 27.1; 27.5; 28.1; 53.6; 80.8; 83.9; 87.3; 106.2; 120.7; 124.6; 129.7; 133.8; 135.7; 147.2; 150.3; 150.9; 159.9; 200.7. Anal. calc. for $C_{19}H_{19}N_3O_6$ (385.37): C 59.22, H 4.97, N 10.90; found: C 59.12, H 4.85, N 10.77.

*5,5a,5b,10b,11a,12-Hexahydro-5b,10b-dihydroxy-11a-methyl-1-phenyl-2*H*-indeno[2″,1″:4′,5′]furo[3′,2′:5,6]pyrido[2,3-*d*]pyrimidine-2,4,6(1*H*,3*H*)-trione* (**3c**). White powder. M.p. 185° (dec.). IR (KBr): 3420, 3287, 1723, 1598. ^{1}H-NMR ((D$_6$)DMSO, 400 MHz): 1.39 (*s*, Me); 2.30–2.43 (*m*, CH); 2.65 (*d*, *J* = 6.8, CH); 3.08 (*d*, *J* = 16.8, CH); 4.88 (*s*, 1 H, NH or OH); 5.55 (*s*, 1 H, NH or OH); 6.16 (*s*, 1 H, NH or OH); 7.07–7.14 (*m*, 3 arom. H); 7.37 (*t*, *J* = 4.0, 2 arom. H); 7.59 (*d*, *J* = 7.2, 1 arom. H); 7.68–7.89

(*m*, 3 arom. H); 10.57 (*s*, 1 H, NH). ^{13}C-NMR ((D$_6$)DMSO, 100 MHz):16.4; 27.6; 52.0; 80.7; 83.2; 87.7; 106.9; 122.5; 125.1; 128.9; 129.5; 130.2; 130.7; 133.1; 134.6; 136.7; 147.4; 150.3; 152.3; 162.1; 201.4. Anal. calc. for $C_{23}H_{19}N_3O_6$ (433.41): C 63.74, H 4.42, N 9.70; found: C 63.65, H 4.32, N 9.58.

*5,5a,5b,10b,11a,12-Hexahydro-5b,10b-dihydroxy-11a-methyl-1-phenyl-2-thioxo-2*H*-indeno-[2″,1″:4′,5′]furo[3′,2′:5,6]pyrido[2,3-*d*]pyrimidine-4,6(1*H*,3*H*)-dione* (**3d**). White powder. M.p. 190° (dec.). IR (KBr): 3460, 3409, 1716, 1638. ^{1}H-NMR ((D$_6$)DMSO, 400 MHz): 1.38 (*s*, Me); 2.40 (*dd*, *J* = 17.2, 7.2, CH); 2.68 (*d*, *J* = 6.8, CH); 3.13 (*d*, *J* = 16.8, CH); 4.68 (*s*, 1 H, NH or OH); 5.60 (*s*, 1 H, NH or OH); 6.22 (*s*, 1 H, NH or OH); 7.04 – 7.14 (*m*, 3 arom. H); 7.36 – 7.40 (*m*, 2 arom. H); 7.57 (*d*, *J* = 7.6, 2 arom. H); 7.70 (*d*, *J* = 3.6, 2 arom. H); 12.08 (*s*, 1 H, NH). ^{13}C-NMR ((D$_6$)DMSO, 100 MHz):16.4; 27.6; 52.0; 80.7; 83.2; 87.7; 106.9; 122.5; 125.1; 128.9; 129.5; 130.4; 131.0; 133.1; 134.6; 136.7; 148.5; 152.3; 159.9; 175.8; 201.4. Anal. calc. for $C_{23}H_{19}N_3O_5S$ (449.48): C 61.46, H 4.26, N 9.35, S 7.13; found: C 61.32, H 4.13, N 9.22, S 7.02.

*5,5a,5b,10b,11a,12-Hexahydro-5b,10b-dihydroxy-1,11a-dimethyl-2-thioxo-2*H*-indeno[2″,1″:4′,5′]-furo[3′,2′:5,6]pyrido[2,3-*d*]pyrimidine-4,6(1*H*,3*H*)-dione* (**3e**). White powder. M.p. 205° (dec.). IR (KBr): 3364, 3352, 1717, 1641. ^{1}H-NMR ((D$_6$)DMSO, 400 MHz): 1.54 (*s*, Me); 2.24 (*dd*, *J* = 16.8, 6.0, CH); 2.65 (*d*, *J* = 5.6, CH); 2.80 (*s*, Me); 2.91 (*d*, *J* = 16.4, CH); 6.19 (*s*, 1 H, NH or OH); 6.77 (*s*, 1 H, NH or OH); 7.15 (*s*, 1 H, NH or OH); 7.29 (*d*, *J* = 7.8, 1 arom. H); 7.47 (*t*, *J* = 8.1, 1 arom. H); 7.75 – 7.90 (*m*, 2 arom. H); 11.78 (*s*, 1 H, NH). ^{13}C-NMR ((D$_6$)DMSO, 100 MHz): 16.4; 26.8; 28.8; 53.2; 84.1; 87.3; 87.9; 106.8; 121.3; 125.1; 130.3; 134.3; 136.3; 148.6; 151.7; 158.6; 174.9; 201.4. Anal. calc. for $C_{18}H_{17}N_3O_5S$ (387.41): C 55.80, H 4.42, N 10.85, S 8.28; found: C 55.72, H 4.33, N 10.75, S 8.18.

*6-Amino-5-[(4,8b-dihydro-3a,8b-dihydroxy-2-methyl-4-oxo-3a*H*-indeno[1,2-*b*]furan-3-yl)methyl]-1,3-dimethylpyrimidine-2,4(1*H*,3*H*)-dione* (**4b**). White powder. M.p. 140° (dec.). ^{1}H-NMR ((D$_6$)DMSO, 400 MHz): 1.70 (*s*, Me); 2.70 (*d*, *J* = 16.6, CH); 3.10 (*s*, Me); 3.20 (*d*, *J* = 16.6, 1 H, CH); 3.30 (*s*, Me); 6.60 (*s*, 1 H, OH); 6.80 (*s*, 2 H, NH$_2$); 7.50 (*s*, 1 H, OH); 7.60 – 8.00 (*m*, 4 arom. H). ^{13}C-NMR ((D$_6$)DMSO, 100 MHz): 12.3; 17.1; 27.7; 29.9; 84.2; 86.2; 106.2; 122.6; 126.2; 130.6; 133.6; 136.3; 144.5; 146.3; 149.4; 150.8; 151.9; 161.9; 200.3.

*6-(2,3-Dihydro-2-hydroxy-1,3-dioxo-1*H*-inden-2-yl)-5,8-dihydro-1,3-dimethylpyrido[2,3-*d*]pyrimidine-2,4,7(1*H*,3*H*,6*H*)-trione* (**6a**). White powder. M.p. 255° (dec.). IR (KBr): 3230, 1722, 1682. ^{1}H-NMR ((D$_6$)DMSO, 400 MHz): 3.17 (*dd*, *J* = 12.9, 5.8, CH); 3.29 (*s*, Me); 2.93 – 3.01 (*m*, CH); 3.30 (*s*, Me); 3.40 (*dd*, *J* = 11.9, 5.8, CH); 6.96 (*s*, 1 H, OH); 7.97 – 8.02 (*m*, 4 arom. H); 10.60 (*s*, 1 H, NH). ^{13}C-NMR ((D$_6$)DMSO,100 MHz): 18.5; 28.6; 31.2; 45.4; 72.8; 89.4; 124.1; 124.4; 136.9; 137.2; 141.3; 141.6; 146.2; 151.6; 161.6; 172.2; 199.2; 200.2. Anal. calc. for $C_{18}H_{15}N_3O_6$ (369.33): C 58.54, H 4.09, N 11.38; found: C 58.42, H 4.00, N 11.27.

*6-(2,3-Dihydro-2-hydroxy-1,3-dioxo-1*H*-inden-2-yl)-5,8-dihydro-1-phenylpyrido[2,3-*d*]pyrimidine-2,4,7(1*H*,3*H*,6*H*)-trione* (**6b**). White powder. M.p. 258° (dec.). IR (KBr): 3340, 1716, 1635. ^{1}H-NMR ((D$_6$)DMSO, 400 MHz): 2.90 – 2.99 (*m*, CH); 3.17 (*dd*, *J* = 16.1, 7.3, CH); 3.50 (*dd*, *J* = 14.8, 7.1, CH); 6.98 (*s*, 1 H, OH); 7.35 – 7.50 (*m*, 6 arom. H); 7.93 – 8.04 (*m*, 4 arom. H); 9.50 (*s*, 1 H, NH); 11.35 (*s*, 1 H, NH). ^{13}C-NMR ((D$_6$)DMSO, 100 MHz): 17.0; 28.6; 44.5; 71.9; 89.2; 123.2; 123.5; 129.2; 136.0; 136.3; 140.4; 140.7; 150.1; 161.8; 198.4; 199.5. Anal. calc. for $C_{22}H_{15}N_3O_6$ (417.37): C 63.31, H 3.62, N 10.07; found: C 63.21, H 3.52, N 9.95.

*6-(2,3-Dihydro-2-hydroxy-1,3-dioxo-1*H*-inden-2-yl)-2,3,5,8-tetrahydro-1-methyl-2-thioxopyrido[2,3-*d*]pyrimidine-4,7(1*H*,6*H*)-dione* (**6c**). White powder. M.p. 272° (dec.). IR (KBr): 3345, 3156, 1638, 1496. ^{1}H-NMR ((D$_6$)DMSO, 400 MHz): 2.96 (*dd*, *J* = 16.2, 15.6, CH); 3.17 (*dd*, *J* = 16.4, 6.8, CH); 3.45 (*dd*, *J* = 15.0, 7.2, CH); 3.69 (*s*, Me); 7.02 (*s*, 1 H, OH); 7.99 – 8.06 (*m*, 4 arom. H); 10.67 (*s*, 1 H, NH); 12.61 (*s*, 1 H, NH). ^{13}C-NMR ((D$_6$)DMSO, 100 MHz): 17.6; 36.9; 75.6; 96.0; 122.6; 123.8; 124.1; 125.9; 131.3; 132.9; 136.6; 136.9; 140.9; 141.2; 147.2; 159.3; 171.7; 175.9; 198.8; 199.8. Anal. calc. for $C_{17}H_{13}N_3O_5S$ (371.37): C 54.98, H 3.53, N 11.31, S 8.63; found: C 54.88, H 3.44, N 11.22, S 6.53.

*6-(2,3-Dihydro-2-hydroxy-1,3-dioxo-1*H*-inden-2-yl)-2,3,5,8-tetrahydro-1,3-dimethyl-2-thioxopyrido[2,3-*d*]pyrimidine-4,7(1*H*,6*H*)-dione* (**6d**). White powder. M.p. 262° (dec.). IR (KBr): 3341, 3300, 1697, 1635. ^{1}H-NMR ((D$_6$)DMSO, 400 MHz): 2.96 (*t*, 1 H, *J* = 15.6, CH); 3.17 (*dd*, *J* = 14.9, 7.1, CH); 3.42 (*dd*, *J* = 16.4, 7.1, CH); 3.57 (*s*, Me); 3.71 (*s*, Me); 6.98 (*s*, 1 H, OH); 7.94 – 8.00 (*m*, 4 arom. H); 10.72 (*s*, 1 H, NH). ^{13}C-NMR ((D$_6$)DMSO,100 MHz): 17.9; 35.5; 44.0; 71.7; 94.1; 123.3; 123.7; 136.2; 136.5; 140.4;

140.7; 146.0; 158.9; 171.2; 176.1; 198.3; 199.4. Anal. calc. for $C_{18}H_{15}N_3O_5S$ (385.39): C 56.10, H 3.92, N 10.90, S 8.32; found: C 56.01, H 3.76, N 10.75, S 8.21.

*6-(2,3-Dihydro-2-hydroxy-1,3-dioxo-1 H-inden-2-yl)-5,8-dihydro-1-methylpyrido[2,3-*d*]pyrimidine-2,4,7(1*H*,3*H*,6*H*)-trione* (**6e**). White powder. M.p. 265° (dec.). IR (KBr): 3382, 3179, 1764, 1717. ^{1}H-NMR ((D$_6$)DMSO, 400 MHz): 2.89–2.93 (*m*, CH); 3.30 (*dd*, *J* = 16.0, 7.2, CH); 3.34 (*s*, Me); 3.36–3.43 (*m*, CH); 6.98 (*s*, 1 H, OH); 8.00–8.04 (*m*, 4 arom. H); 10.50 (*s*, 1 H, NH); 11.20 (*s*, 1 H, NH). ^{13}C-NMR ((D$_6$)DMSO, 100 MHz): 17.5; 29.8; 44.9; 72.4; 89.7; 123.8; 124.2; 136.6; 136.9; 140.9; 141.3; 147.1; 151.0; 162.0; 172.0; 198.9; 199.9. Anal. calc. for $C_{17}H_{13}N_3O_6$ (355.30): C 57.47; H 3.69; N 11.83; found: C 57.36, H 3.58, N 11.73.

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