Efficient Niementowski synthesis of novel derivatives of 1,2,9,11-tetrasubstituted-7*H*-thieno[2',3':4,5]pyrimido[6,1-*b*]-quinazolin-7-one

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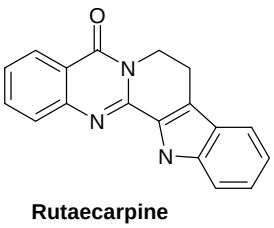
Abstract
Starting from 5,6-disubstituted-3*H*-thieno[2,3-*d*]pyrimidin-4-ones, novel 1,2,9,11-tetrasubstituted-7*H*-thieno[2',3':4,5]pyrimido[6,1-*b*]quinazolin-7-ones could be reached in two steps through a von Niementowski reaction, which involves condensation of substituted anthranilic acids with a 4-chloro-5,6-disubstituted-3*H*-thieno[2,3-*d*]pyrimidines. Microwave irradiation in acetic acid media was used in order to improve reactions where conventional heating was limited

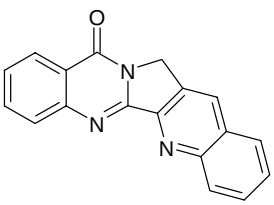
Keywords: Sulphur heterocycles, fused thieno[2,3-*d*]pyrimidine, cyclization, microwave assisted synthesis

Introduction

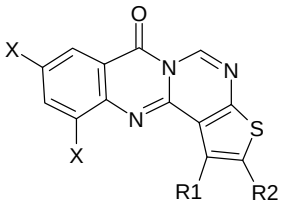
A literature survey has revealed the diversified biological and pharmacological significance of several nitrogen and sulphur heterocycles. This aspect has been drawing the attention of many researchers towards exploiting the biological importance of various heterocyclic compounds and to establish the relationship between their biological, pharmacological potency and structural features. A rapid progress in the work on fused quinazolinones and thienopyrimidines has given rise to a number of compounds exhibiting potent pharmacological actions.



Rutaecarpine



Luotonine A3



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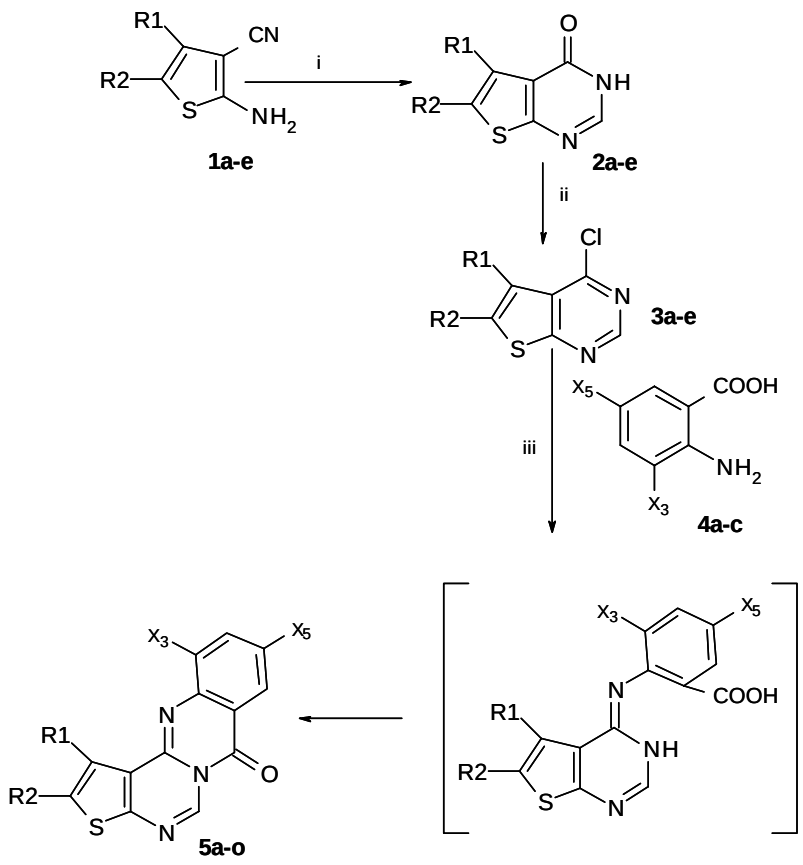
Thieno[2,3-d]pyrimidines are an important class of fused heterocycles with a wide range of biological activities such as anti-allergic activity,[1-3] analgesic,[4-7] anti-inflammatory,[4-9] blood sugar lowering properties,[4] CNS depressant[10-12] activities, anticonvulsant,[8] antimicrobials,[13] local anaesthetic,[9] antitussive activity,[9] potent PDE 4[14] and PDE 5 inhibitory activity[15-21] and many more. Rutaecarpine[22] and Luotonine A[23] (Figure 1), the two natural quinazoline fused compounds exhibit a very potent pharmacological values. In search of new fused heterocyclic compounds with potential pharmaceutical value and in association with our work[13, 24-26] on the application of microwaves in organic chemistry, we planned to prepare novel tetracyclic 1,2,9,11-tetrasubstituted-7*H*-thieno[2',3':4,5]pyrimido[6,1-*b*]quinazolin-7-ones **(5)**, from the reaction between anthranilic acids **(4)** and thieno[2,3-d]pyrimidine rings **(3)**. The synthesis of various congeners took place via a Niementowski condensation, inspired by Alexandre and co-workers.[27]

During the next few years the implementation of strict environmental legislation, entails a challenge for chemists that will strive to develop novel products and processes that will provide all the benefits of sustainable development. This requires a novel synthetic approach which will reduce the time and energy intensity of chemical processes and products, decrease or eliminate the dispersion of harmful chemicals in the environment in a way that will enhance industry to meet the challenges of green chemistry.[28] One area where substantial progress has been made is microwave-assisted synthesis.[29] Microwaves have shown an advantage when processes involve sensitive reagents or products that may decompose under prolonged heating. This technique is particularly attractive for multi-step syntheses[30] and drug discovery[31] where the ability of efficient purification is highly desirable. In this paper we describe the synthesis of the novel 7*H*-thieno[2',3':4,5]pyrimido[6,1-*b*]quinazolin-7-one ring system **5** under microwave conditions with the aim of developing a novel and environmentally friendly procedure.

Results and Discussion

The synthesis of the 5,6-disubstituted-3*H*-thieno[2,3-*d*]pyrimidin-4-ones **2** was performed by reaction between 2-amino-4,5-disubstituted-thiophene-3-carbonitrile and formic acid.[32] Short exposure (10 min) of a mixture of the **2** with phosphoryl chloride to microwave irradiation led to 4-chloro-3*H*-thieno[2,3-*d*]pyrimidines **3** in very good yields. The final step of this route involves a Niementowski reaction[33] between anthranilic acids **4** and novel 4-chloro-3*H*-thieno[2,3-*d*]pyrimidines **3**. These reactions are carried out either under microwave irradiation or by conventional heating. It is assumed that the reaction goes via an acid intermediate (Scheme 1) that undergoes intramolecular acyl substitution between a pyrimidine ring nitrogen atom and the acid group to yield compounds **5**. A comparative study between conventional heating (Method A) and microwave irradiation (Method B) revealed that the microwave reactions were cleaner and higher yielding (Table 1**)**. To our knowledge, very few examples of these type of reaction have been reported.[25, 34-36]



Scheme 1. (i) HCOOH, reflux. (ii) $POCl_3$, microwave irradiation. (iii) CH_3COOH, microwave irradiation or CH_3COOH, reflux.

Table 1. Physical data of compound **5a-o**

Compd	Substitution				Reaction time (min)		Yield (%)[@]		Mp. (^oC)
					Method		Method		
	R_1	**R_2**	**X_3**	**X_5**	**A**	**B[$]**	**A**	**B**	
5a	-$(CH_2$-$)_4$		H	H	90	10	60	95	88-90
5b	p-Cl-phenyl	H	H	H	60	05	70	80	116-118
5c	p-methyl-phenyl	H	H	H	90	06	65	85	220-222
5d	p-methoxy-phenyl	H	H	H	60	07	70	85	120-122
5e	CH_3	CH_3	H	H	60	05	60	80	130-132
5f	-$(CH_2$-$)_4$		Br	Br	75	08	60	90	118-120
5g	p-Cl-phenyl	H	Br	Br	60	07	65	95	108-110
5h	p-methyl-phenyl	H	Br	Br	90	08	70	90	128-130

Table 1. Continued

Compd	Substitution				Reaction time (min)		Yield (%)[@]		Mp. (°C)
					Method		Method		
	R_1	**R_2**	**X_3**	**X_5**	**A**	**B[$]**	**A**	**B**	
5i	p-methoxy-phenyl	H	Br	Br	90	08	70	85	135-137
5j	CH_3	CH_3	Br	Br	60	05	60	80	178-180
5k	-$(CH_2$-$)_4$		H	Br	75	08	70	95	238-240
5l	p-Cl-phenyl	H	H	Br	60	07	60	85	148-150
5m	p-methyl-phenyl	H	H	Br	60	08	70	90	160-162
5n	p-methoxy-phenyl	H	H	Br	60	08	75	85	122-124
5o	CH_3	CH_3	H	Br	60	06	60	80	150-152

[$] 140 W power input; [@] Yield of pure product obtained by method A and B

The IR (KBr) spectra of **5** showed characteristic C=O stretching vibrations in the region 1700-1675cm^{-1}. The C=C and C=N ring stretching vibrations appeared around 1600 and 1570-1520 cm^{-1}. The IR bands due to NH and COOH vibrations were not present in any of the spectra of the compounds **5** which ruled out any intermediates being isolated. Direct cyclization to compounds **5** is also supported by ^{1}H-NMR spectral data and is due to the absence of any NH or OH signals.

Conclusions

We observed that the best procedure for the preparation of 1,2,9,11-tetra substituted-7*H*-thieno[2',3':4,5]pyrimido[6,1-*b*]quinazolin-7-ones consists of microwave irradiation (140 W Power input) of a mixture of the 4-chloro-5,6-disubstituted-thieno[2,3-*d*]pyrimidine with an excess of appropriately substituted anthranilic acids in the presence of acetic acid. The benefits of using microwave irradiation are noticeable and high temperatures, lengthy and tedious conditions of conventional heating are avoided. This work is a further example of the utility of microwave irradiation in organic synthesis. The synthesized compounds are structurally related to terrestrial alkaloids such as Rutaecarpine and Luotonine A. Phosphodiesterase inhibitory activity of various analogues is under development and will be described later.

Experimental Section

General Procedures. The microwave irradiated reactions (MWI) were performed in scientific microwave oven RAGA's microwave oven. Melting points were determined in open capillaries

using a Thermonik C-PMB-2 precision melting point and boiling point apparatus (Mumbai, India) and are uncorrected. The purity of the compound was routinely checked by TLC using silica gel-G and the spots were exposed in iodine vapour. IR spectra were recorded using KBr pellets on a Shimadzu 1600 Spectrophotometer from Shimadzu International Incorporation, (ν_{max} cm^{-1}), ^1H NMR spectra on Bruker Avance 400 Spectrometer (Bruker AG, Fallanden, Switzerland) at 400 MHz using TMS as internal standard ($CDCl_3$ and chemical shift in δ ppm) and mass spectra (EI-MS) were recorded on a Jeol SX-102 spectrometer(Jeol, Ltd.Tokyo, Japan). Elemental analyses were carried out at Heraeus Carlo Erba 1180 CHN analyzer (from Heraeus Instrument GmbH, Hanau, Germany). All the chemicals were purchased from Aldrich Company Ltd., Dorset (UK).

Synthesis of substituted products of 2-amino-4,5-disubstituted-thiophene-3-carbonitriles 1a-e

These compounds were synthesized from appropriately substituted aldehydes and ketones using known procedure described by Gewald.[37] The products **1a-e** was recrystallizd from ethanol and obtained in pure form.

Synthesis of substituted products of 5,6-disubstituted-3*H*-thieno[2,3-d]pyrimidin-4-ones 2a-e

These compounds were synthesized by heating compound **1** in formic acid at reflux temperature.[32] The product **2** was obtained in pure form by recrystallization from ethanol.

Synthesis of substituted products of 4-chloro-5, 6-disubstituted-3*H*-thieno[2, 3-d]pyrimidines 3a-e

Thienopyrimidin-4-one **2** (4.42 mmole) and $POCl_3$ (6 mL) were irradiated in a microwave oven (140 W power input) until the reaction reached completion (TLC monitoring, 12 min). $POCl_3$ was evaporated in vacuo and the residue was dissolved in EtOAc. The organic phase was washed with saturated $NaHCO_3$ solution, dried (Na_2SO_4) and concentrated in vacuo to furnish compound **3** as an off-white solid which was used without further purification in the next.

4-Chloro-5,6-disubstituted-3*H*-thieno[2,3-*d*]pyrimidines (**3a**, 85% yield; **3b**, 90% yield; **3c**, 80% yield; **3d**, 85% yield; **3e**, 90% yield;) gave spectroscopic data in accordance with those previously described.[32]

Synthesis of substituted anthranilic acids 4a-c

The monobromo and dibromo derivatives of anthranilic acid were obtained using reported method.[38]

Synthesis of 1,2,9,11-tetrasubstituted-7*H*-thieno[2',3':4,5]pyrimido[6,1-*b*]quinazolin-7-ones 5. General procedures

Method A (Classical). A mixture of **3** (0.61 mmole) and anthranilic acid **4** (3.4 mmole) in CH_3COOH (10 ml) was refluxed for 1.5 hr. The reaction mixture was cooled to room

temperature and solvent was evaporated under reduced pressure. Recrystallization from ethanol afforded compound **5**.

Method B (Microwave). A mixture of **3** (0.61 mmole) and anthranilic acid **4** (3.4 mmole) in CH_3COOH (5ml) was introduced in pyrex tube. The tube was irradiated in microwave (140 W power input) for 10 min. After reaction solvent was evaporated under reduced pressure. Recrystallization from ethanol afforded compound **5**.

1,2,3,4-Tetrahydro-9*H*-[1]benzothieno[2',3':4,5]pyrimido[6,1-*b*]quinazolin-9-one(5a). IR (KBr) vmax: 1750 (C=O), 1662 (C=N) cm^{-1}; ^{1}H-NMR (400 MHz, CDCl3) δ (ppm): 1.83-1.87 (m, 4H), 2.78 (t, 2H), 3.07 (t, 2H), 7.10-8.35 (m, 5H); ^{13}C-NMR (75 MHz, $CDCl_3$) δ (ppm): 23.4, 23.4, 23.8, 24.9, 120.8, 126.6, 126.7, 127.3, 127.6, 129, 133.4, 137.4, 143.7, 144.5, 155.9, 163, 170.6; *m*/*z* (EI): 307 (M+, 25 %); Anal. Calcd. for $C_{17}H_{13}N_3OS$: C, 66.43; H, 4.26; N, 13.67. Found: C, 66.12; H, 4.18; N, 13.73%.

1-(4-Chlorophenyl)-7*H*-thieno[2',3':4,5]pyrimido[6,1-*b*]quinazolin-7-one (5b). IR (KBr) vmax: 1751 (C=O), 1685 (C=N) cm^{-1}; ^{1}H-NMR (400 MHz, $CDCl_3$, δ in ppm) 7.42-8.50 (m, 1H thiophene + 9H Ar-H); 13C NMR ($CDCl_3$, 75 MHz, δ in ppm) 120.8, 124, 125.3, 125.3, 125.5, 126.6, 126.7, 127.3, 129.3, 129.3, 133.4, 134.3, 134.5, 142.6, 144.5, 148.6, 155.9, 163, 170.6 ; *m*/*z* (EI): 363 (M^++2, 20 %); Anal. calcd for $C_{19}H_{10}ClN_3OS$: C, 62.73; H, 2.77; N, 11.55. Found: C, 62.25; H, 2.89;N 11.34.

1-(4-Tolyl)-7*H*-thieno[2',3':4,5]pyrimido[6,1-*b*]quinazolin-7-one (5c). IR (KBr) vmax: 1685 (C=O), 1600 (C=N) cm^{-1}; ^{1}H-NMR (400 MHz, $CDCl_3$, δ in ppm) 2.48 (s,3H, CH3), 7.01-8.49 (m, 1H thiophene + 9H Ar-H); ^{13}C-NMR ($CDCl_3$, 75 MHz, δ in ppm) 21.3, 120.8, 124, 125.5, 126.6, 126.7, 127.3, 127.4, 127.4, 129.5, 129.5, 131.7, 133.4, 133.4, 142.6, 144.5, 148.6, 155.9, 163, 170.6 ; *m*/*z* (EI): 343 (M^++2, 18 %); Anal. calcd for $C_{20}H_{13}N_3OS$: C, 69.95; H, 3.82;, N, 12.24. Found: C, 69.72; H, 3.93; N 12.13.

1-(4-Methoxyphenyl)-7*H*-thieno[2',3':4,5]pyrimido [6,1-*b*]quinazolin-7-one (5d). IR (KBr) vmax: 1757 (C=O), 1685 (C=N) cm^{-1}; ^{1}H-NMR (400 MHz, $CDCl_3$, δ in ppm) 3.84 (s,3H, OCH3)7.02-8.85 (m, 1H thiophene + 9H Ar-H); 13C NMR ($CDCl_3$, 75 MHz, δ in ppm) 55.8, 114.8, 114.8, 120.8, 124, 125.6, 126.6, 126.7, 127.3, 128.7, 129.7, 129.7, 133.4, 142.6, 144.5, 148.6, 155.9, 160.6, 163, 170.6 ; *m*/*z* (EI): 359 (M^++2, 20 %); Anal. calcd for $C_{20}H_{13}N_3O_2S$: C, 66.84; H, 3.65; N, 11.69. Found: C, 66.93; H, 3.54; N, 11.78.

1,2-Dimethyl-7*H*-thieno[2',3':4,5]pyrimido[6,1-*b*]quinazolin-7-one (5e). IR (KBr) vmax: 1685 (C=O), 1600 (C=N); ^{1}H-NMR (400 MHz, $CDCl_3$, δ in ppm) 2.40 (s,3H, CH3), 2.50 (s,3H, CH3), 7.10-8.40 (m, 5H Ar-H); ^{13}C-NMR ($CDCl_3$, 75 MHz, δ in ppm) 10.2, 10.4, 120.8, 126.6, 126.7, 127.3, 129, 131.4, 133.4, 136, 144.3, 144.5, 155.9, 163, 170 ; *m*/*z* (EI): 281 (M^++2, 22 %); Anal. calcd for $C_{15}H_{11}N_3OS$: C, 64.04; H, 3.94; N, 14.94. Found: C, 64.23; H, 3.72; N 14.68.

9,11-Dibromo-1,2,3,4-tetrahydro-9*H*-[1]benzothieno[2',3':4,5]pyrimido[6,1-*b*]quinazolin-9-one (5f). IR (KBr) vmax: 1762 (C=O), 1683 (C=N) cm^{-1}; ^{1}H-NMR (400 MHz, $CDCl_3$, δ in ppm) 1.79-1.85 (m, 4H), 2.80 (t, 2H), 3.12 (t, 2H), 7.12-8.40 (m, 3H); 13C NMR (CDCl3, 75 MHz, δ in ppm) 23.4, 23.4, 23.8, 24.9, 113.2, 122.0, 125.2, 127.6, 129, 131.3, 137.4, 139.4, 143.7, 150.1,

155.9, 163, 170.6 ; *m*/*z* (EI): 281 (M^++2, 18 %); Anal. calcd for $C_{17}H_{11}Br_2N_3OS$: C, 43.90; H, 2.38; N, 9.03. Found: C, 43.87; H, 2.42; N, 9.12.

9,11-Dibromo-1,2-dimethyl-7*H*-thieno[2',3':4,5]pyrimido[6,1-*b*]quinazolin-7-one(5g). IR (KBr) vmax: 1762 (C=O) stretching, 1667 (C=N) cm^{-1}; ^{1}H-NMR (400 MHz, $CDCl_3$, δ in ppm) 2.38 (s,3H, CH3), 2.52 (s,3H, CH3), 7.50-8.35 (m,3H Ar-H); ^{13}C-NMR ($CDCl_3$, 75 MHz, δ in ppm) 10.2, 10.4, 113.2, 122.0, 125.2, 129, 131.3, 131.4, 136, 139.4, 144.3, 150.1, 155.9, 163, 170.6 ; *m*/*z* (EI): 439 (M^++2, 21 %);Anal. calcd for $C_{15}H_9Br_2N_3OS$: C, 41.03; H, 2.07; N, 9.57. Found: C, 41.22; H, 2.32; N, 9.48.

9,11-Dibromo-1-(4-chlorophenyl)-7*H*-thieno[2',3':4,5]pyrimido[6,1-*b*]quinazolin-7-one (5h). IR (KBr) vmax: 1766 (C=O), 1683 (C=N) cm^{-1}; ^{1}H-NMR (400 MHz, $CDCl_3$, δ in ppm) 7.40-8.45 (m, 1H thiophene + 7H Ar-H); ^{13}C-NMR ($CDCl_3$, 75 MHz, δ in ppm) 113.2, 122.0, 124, 125.2, 125.3, 125.3, 125.5, 129.3, 129.3, 131.3, 134.3, 134.5, 139.4, 142.6, 148.6, 150.1, 155.9, 163, 170.6 ; *m*/*z* (EI): 521 (M^++2, 17 %); Anal. calcd for $C_{19}H_8Br_2ClN_3OS$: C, 43.75; H, 1.55; N, 8.06. Found: C, 43.87; H, 1.49; N 8.17.

9,11-Dibromo-1-(4-tolyl)-7*H*-thieno[2',3':4,5]pyrimido[6,1-*b*]quinazolin-7-one (5i). IR (KBr) vmax: 1750 (C=O), 1678 (C=N) cm^{-1}; ^{1}H-NMR (400 MHz, $CDCl_3$, δ in ppm) 2.39 (s,3H, CH3), 7.12-8.45 (m, 1H thiophene + 7H Ar-H); ^{13}C-NMR ($CDCl_3$, 75 MHz, δ in ppm) 21.3, 113.2, 122, 124, 125.2, 125.5, 127.4, 127.4, 129.5, 129.5, 131.3, 131.7, 133.4, 139.4, 142.6, 148.6, 150.1, 155.9, 163, 170.6 ; *m*/*z* (EI): 501 (M^++2, 19 %); Anal. calcd for $C_{20}H_{11}Br_2N_3OS$: C, 47.93; H, 2.21; N, 8.38. Found: C, 47.72; H, 2.34; N 8.45.

9,11-Dibromo-1-(4-methoxyphenyl)-7*H*-thieno[2',3':4,5]pyrimido[6,1-*b*]quinazolin-7-one (5j). IR (KBr) vmax: 1760 (C=O), 1678 (C=N) cm^{-1}; ^{1}H-NMR (400 MHz, $CDCl_3$, δ in ppm) 3.75 (s,3H, OCH3), 7.13-8.78 (m, 1H thiophene + 7H Ar-H); 13-C-NMR ($CDCl_3$, 75 MHz, δ in ppm) 55.8, 113.2, 114.8, 114.8, 122, 124, 125.2, 125.5, 128.7, 129.7, 129.7, 131.3, 139.4, 142.6, 148.6, 150.1, 155.9, 160.6, 163, 170.6 ; *m*/*z* (EI): 517 (M^++2, 23 %); Anal. calcd for $C_{20}H_{11}Br_2N_3O_2S$: C, 46.45; H, 2.14; N, 8.12. Found: C, 46.23; H, 2.24; N 8.31.

9-Bromo-1,2,3,4-tetrahydro-9*H*-[1]benzothieno[2',3':4,5]pyrimido[6,1-*b*]quinazolin-9-one (5k). IR (KBr) vmax: 1662 (C=O), 1591 (C=N) cm^{-1}; ^{1}H-NMR (400 MHz, $CDCl_3$, δ in ppm) 1.80-1.89 (m, 4H), 2.84 (t, 2H), 3.02 (t, 2H), 7.02-8.48 (m, 4H); ^{13}C-NMR ($CDCl_3$, 75 MHz, δ in ppm) 23.4, 23.4, 23.8, 24.9, 121.7, 123, 124.6, 127.6, 129, 132.3, 136.3, 137.4, 143.5, 143.7, 155.9, 163, 170.6 ; *m*/*z* (EI): 387 (M^++2, 20 %); Anal. calcd for $C_{17}H_{12}BrN_3OS$: C, 52.86; H, 3.13; N, 10.88. Found: C, 52.98; H, 3.29; N 10.92.

9-Bromo-1,2-dimethyl-7*H*-thieno[2',3':4,5]pyrimido[6,1-*b*]quinazolin-7-one (5l). IR (KBr) vmax: 1757 (C=O), 1662 (C=N) cm^{-1}; ^{1}H-NMR (400 MHz, $CDCl_3$, δ in ppm) 2.41 (s,3H, CH3), 2.50 (s,3H, CH3), 8.8-7.08 (m, 4H Ar-H); ^{13}C-NMR ($CDCl_3$, 75 MHz, δ in ppm) 10.2, 10.4, 121.7, 123, 124.6, 129, 131.4, 132.3, 136, 136.3, 143.5, 144.3, 155.9, 163, 170.6 ; *m*/*z* (EI): 387 (M^++2, 20 %); Anal. calcd for $C_{15}H_{10}BrN_3OS$: C, 50.01; H, 2.80; N, 11.66. Found: C, 50.14; H, 2.98; N 11.45.

9-Bromo-1-(4-chloro-phenyl)-7*H*-thieno[2',3':4,5]pyrimido[6,1-*b*]quinazolin-7-one (5m). IR (KBr) vmax: 1757 (C=O), 1676 (C=N) cm^{-1}; ^{1}H-NMR (400 MHz, $CDCl_3$, δ in ppm) 7.12-8.62

(m, 1H thiophene + 8H Ar-H); ^{13}C-NMR ($CDCl_3$, 75 MHz, δ in ppm) 121.7, 123, 124, 124.6, 125.3, 125.3, 125.5, 129.3, 129.3, 132.3, 134.3, 134.5, 136.3, 142.6, 143.5, 148.6, 155.9, 163, 170.6 ; *m*/*z* (EI): 443 (M^++2, 18 %); Anal. calcd for $C_{19}H_9BrClN_3OS$: C, 51.55; H, 2.05; N, 9.49. Found: C, 51.28; H, 2.28; N, 9.67.

9-Bromo-1-(4-tolyl)-7*H*-thieno[2',3':4,5]pyrimido[6,1-*b*]quinazolin-7-one (5n). IR (KBr) vmax: 1757 (C=O), 1610 (C=N) cm^{-1}; ^{1}H-NMR (400 MHz, $CDCl_3$, δ in ppm) 2.41 (s,3H, CH3), 7.18-8.52 (m, 1H thiophene + 8H Ar-H); ^{13}C-NMR ($CDCl_3$, 75 MHz, δ in ppm) 21.3, 121.7, 123, 124, 124.6, 125.5, 127.4, 127.4, 129.5, 129.5, 131.7, 132.3, 133.4, 136.3, 142.6, 143.5, 148.6, 155.9, 163, 170.6 ; *m*/*z* (EI): 423 (M^++2, 21 %); Anal. calcd for $C_{20}H_{12}BrN_3OS$: C, 56.88; H, 2.86; N, 9.95. Found: C, 56.67; H, 2.97; N 9.78.

9-Bromo-1-(4-methoxyphenyl)-7*H*-thieno[2',3':4,5]pyrimido[6,1-*b*]quinazolin-7-one (5o). IR (KBr) vmax: 1768 (C=O), 1682 (C=N) cm^{-1}; ^{1}H-NMR (400 MHz, $CDCl_3$, δ in ppm) 3.78 (s,3H, OCH3), 7.18-8.83 (m, 1H thiophene + 8H Ar-H); ^{13}C-NMR ($CDCl_3$, 75 MHz, δ in ppm) 55.8, 114.8, 114.8, 121.7, 123, 124, 124.6, 125.5, 128.7, 129.7, 129.7, 132.3, 136.3, 142.6, 143.5, 148.6, 155.9, 160.6, 163, 170.6 ; *m*/*z* (EI): 439 (M^++2, 17 %); Anal. calcd for $C_{20}H_{12}BrN_3O_2S$: C, 54.81; H, 2.76; N, 9.59. Found: C, 54.97; H, 2.85; N, 9.78.

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References

1. Kretzschnar, K.; Gabau, G. Ger,(East). Pat., 272, 090, 1989; *Chem. Abstr.* **1990**, *112*, 216953.
2. Kretzschnar, K.; Gabau, G. Ger,(East). Pat., 272,087, 1989; *Chem. Abstr.* **1990,** *112*, 132206.
3. Temple Jr. D. L. Ger. Offen. 324698, 1979; *Chem. Abstr.* **1979**, *91*, 74644.
4. Devani, M. B.; Shishoo, C. J.; Pathak, U. S.; Parikh, S. H.; Shah, G. J.; Padhya, A. C. *J. Pharm. Sci.,* **1976**, *65*, 660.
5. Sauter, F. Ger. Offen., 2, 104, 435, 1971; *Chem. Abstr.* **1971**, *75*, 140883.
6. Tahara, T.; Hamasak, T. Japan Kokai, 75140487, 1975; *Chem. Abstr.* **1976**, *85*, 21428.
7. Monique, P.; Duc, M.I.; Francois, C.; Guy, N. *Eur. J. Med. Chem. Ther.* **1984**, 19(5), 420.
8. Devani, M. B.; Shishoo, C. J.; Pathak, U. S.; Parikh, S. H.; Radhakrishnan, A. V.; Padhya, A. C. *Indian. J. Chem.* **1976**, 14, 357.
9. Sauter, A.; Gerhard, S. *Arch. Pharm.* **1976,** 101, 309.
10. Manhas, M. S.; Sharma, S. D.; Sharma, S. G. *J. Med. Chem.* **1972,** 15, 106.
11. Nakanishi, M.; Shiroki, M. Jap. Pat. 7,242, 271, 1972; *Chem. Abstr.* **1976,** *85*, 160152.

12. Kulshreshtha, M. J.; Bhatt, S.; Madhuri, P.; Khanna, N. M. *J. Indian Chem. Soc.* **1981,** 58(10), 982.
13. Laddha, S. S.; Wadodkar, S. G.; Meghal, S.P. *Med. Chem. Res.*(Accepted)
14. Kim, D.-K.; Lee, J.Y.; Ryu, D.H.; Lee, N.K.; Lee, S.H.; Kim, N.-H.; Kim, J.-S.; Ryu, J.H.; Choi, J.-Y.; Im, G-J.; Choi, W.-S.; Kim, T.K.; Cha, H. PCT Int. Appl. WO 01, 60825,2001; *Chem. Abstr.* **2001,** *135*, 195571.
15. Oota, T.; Kawashima, Y.; Hatayama, K. Jpn. Kokai Tokkyo Koho JP 07330777, 1995; *Chem. Abstr.* **1995,** *124*, 289561.
16. Oota, T.; Kawashima, Y.; Hatayama, K. Jpn. Kokai Tokkyo Koho JP 07267961, 1995; *Chem. Abstr.* **1995,** *124*, 146193.
17. Jonas, R.; Kluxen, F.-W.; Schelling, P.; Christadler, M. Ger. Offen., DE 19752952, 1999; *Chem. Abstr.* **1999,** *131*, 19019.
18. Jonas, R.; Schelling, P.; Kluxen, F.-W.; Christadler, M.; PCT Int. Appl. WO 9955708, 1999; *Chem. Abstr.* **1999,** *131*, 310646.
19. Rochus, J.; Eiermann, V.; Bernotat-Danielowski, S. Ger. Offen., DE 19943815, 2001; *Chem. Abstr.* **2001,** *134*, 242642.
20. Eiermann, V.; Jonas, R. Ger. Offen., DE 19944604, 2001; *Chem. Abstr.* **2001,** *134*, 237491.
21. Jonas, R.; Schelling, P.; Christadler, M.; Beier, N. PCT Int. Appl. WO 020064, 2002; *Chem. Abstr.* **2002,** *136*, 85819.
22. Yang, L.-M.; Chen, C.-F.; Lee, K.-H. *Bioorg. Med. Chem. Lett.* **1995**, *5*, 465, and references therein.
23. Ma, Z.-Z.; Hano, Y.; Nomura, T.; Chen, Y.-J. *Heterocycles* **1997**, *46*, 541.
24. Laddha, S. S.; Wadodkar, S. G.; Meghal, S.P. *Arkivoc* **2006**, (*xi)*, 1.
25. Laddha, S. S.; Bhatnagar, S. P. *Arkivoc* **2007**, (*xvi),* 1.
26. Laddha, S. S.; Bhatnagar, S. P. *Phosphorus, Sulphur and Silicon* **2008**, *183:9,* 2262.
27. Alexandre,F-R.; Berecibar, A.; Wrigglesworth, R.; Besson, T.; *Tetrahedron* **2003**, *59* 1413.
28. Xie, W.; Jin, Y.; Wang, P.G. *Chemtech.* **1999**, *29*, 23.
29. Varma, R.S. *Green Chem.* **1999,** *1*, 43.
30. Besson, T.; Guillard, J.; Rees, C. W. *Tetrahedron Lett.* **2000**, *41*, 1027.
31. Wathey, B.; Tierney, J.; Lidstrom, P.; Westman, J. *Drug Discov. Today* **2002**, *7*, 373.
32. Murumkar, P.R. M-Pharm. Thesis submitted to North Maharastra University, Jalgaon, **2004.**
33. Von Niementowski, S. *J. Prakt. Chem.* **1895**, *51*, 564.
34. Abdel-Fattah, A. M.; Aly, A. S.; Gad, F. A.; Hassan, N. A.; El-Gazzar, A. B. A. *Phosphorus, Sulfur and Silicon* **2000**, *163*, 1.
35. Bora, R. O.; Rathod, I. S.; Toshniwal, S. S.; Farooqui, M. *Int. J. Chem. Sci.* **2005**, *3*, 469.
36. Aly, A. S.; El-Gazzar, A. B. A.; Hussein, H. A. R. *Phosphorus Sulfur Silicon.* **2007**, *182*, 35.
37. Gewald, K. *Chem. Ber.*, **1965,** *98*, 3571.
38. Bogert, C.; Hund, G. *J. Chem. Soc.* **1905,** *27*, 1484.