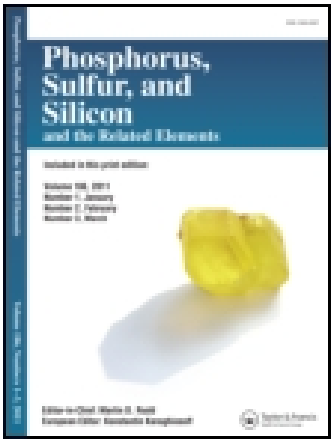

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Synthesis of Some Novel 2-Arylidene Thiazoloquinazolinone Derivatives via One-Pot, Three-Component Reaction

A. Mobinikhaledi [a] , N. Foroughifar [a b] , S. Ebrahimi [c] , F. Rahimi [a] & F. Zandi [b]

[a] Department of Chemistry , Arak University , Arak, Iran

[b] Faculty of Chemistry , Islamic Azad University , North Tehran Branch, North Tehran, Iran

[c] Department of Chemistry , Islamic Azad University , Malayer Branch, Malayer, Iran

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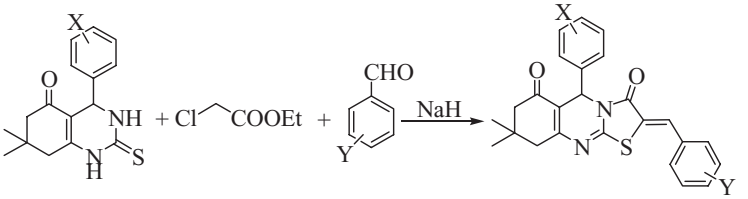
SYNTHESIS OF SOME NOVEL 2-ARYLIDENE THIAZOLOQUINAZOLINONE DERIVATIVES VIA ONE-POT, THREE-COMPONENT REACTION

A. Mobinikhaledi,[1] N. Foroughifar,[1,2] S. Ebrahimi,[3] F. Rahimi,[1] and F. Zandi[2]

[1]Department of Chemistry, Arak University, Arak, Iran
[2]Faculty of Chemistry, Islamic Azad University, North Tehran Branch, North Tehran, Iran
[3]Department of Chemistry, Islamic Azad University, Malayer Branch, Malayer, Iran

GRAPHICAL ABSTRACT



Abstract *A one-pot, multicomponent reaction of thioxoquinazolinone with ethyl chloroacetate and aromatic aldehydes is described for the preparation of novel thiazoloquinazolinone derivatives using sodium hydride in ethanol under reflux conditions. The structures of all synthesized compounds were identified by IR, ^{1}H NMR, ^{13}C NMR, and elemental analysis data.*

Keywords Multicomponent reaction; quinazolinone; thiazoloquinazolinone

INTRODUCTION

Multicomponent reactions (MCRs), in which three or more easily accessible components react to form a single product, are some of the most important reactions in organic synthesis.[1,2] MCRs are a promising field of chemistry because the synthesis of complicated molecules can be achieved in a very fast, efficient, and time-saving manner without the isolation of any intermediate.[3] MCRs are particularly useful to generate diverse chemical libraries of drug-like compounds with biological interest.[4,5] MCRs can provide products

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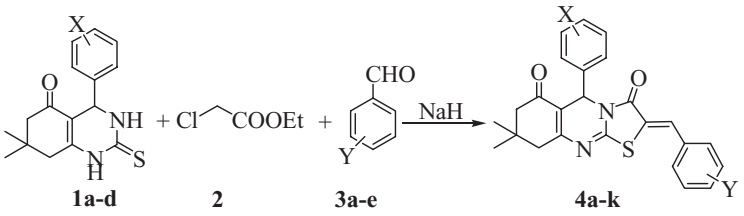
We gratefully acknowledge the financial support from the Research Council of Arak University.
Address correspondence to A. Mobinikhaledi, Department of Chemistry, Arak University, Arak 38156-879, Iran. E-mail: akbar_mobinikhaledi@yahoo.com

with the diversity needed for the discovery of new compounds or modification using combinatorial chemistry methods.[6–8] The search and discovery for new MCRs on one hand,[9] and the full exploitation of already known multicomponent reactions on the other hand, are therefore currently of considerable interest.

The chemistry of thiazolidin-4-one ring systems is of considerable interest as a core structure in various synthetic pharmaceuticals displaying a broad spectrum of biological activities.[10–12] A literature survey reveals that quinazoline derivatives have attracted considerable attention in recent years due to their potential antibacterial activity.[12] Here, due to versatile biological activities of quinazoline, and as a continuation of our research program on the synthesis of thioxoquinazoline derivatives and MCRs,[13–18] we have made an attempt to synthesize some novel thiazoloquinazolinone derivatives in good yield via cyclocondensation reactions.

RESULTS AND DISCUSSION

In the present study, we report our results on a new type of multicomponent reaction where three organic components react to form novel compounds. The starting thioxoquinazolinones **1a–d** were synthesized by the reaction of 5,5-dimethylcyclohexane-1,3-dion (dimedone) and the corresponding aromatic aldehyde with thiourea in the presence of a catalytic amount of silica sulfuric acid (SSA).[19] Further reaction of compounds **1a–d** with aromatic aldehydes **3a–e** and ethyl chloroacetate **2** in the presence of sodium hydride in refluxing ethanol afforded the corresponding thiazoloquinazolinone derivatives **4a–k**, as shown in Scheme 1.



Scheme 1

The reaction conditions between thioxoquinazolinone **1a**, ethyl chloroacetate **2**, benzaldehyde **3a**, and different bases in absolute ethanol were examined (Table 1). Reaction of

Table 1 Optimization of condition for the synthesis of compound **4a**

Entry	Base	Ratio **1a**:base	Yields (%)
1	NaOAc	1:1	10
2	NaOAc	1:2	15
3	NaOH	1:1	15
4	NaOH	1:1.5	16
5	NaOH	1:2	21
6	Pyridine	1:1	<5
7	NaH	1:1	40
8	NaH	1:1.5	56
9	NaH	1:2	57

Table 2 Synthesis of (Z)-2-arylidene-8,8-dimethyl-5-aryl-8,9-dihydro-2H-thiazolo[2,3-b]quinazoline-3,6(5H,7H)-dione derivatives **4a–k**

Entry	X	Y	Mp (°C)	Time (h)	Yields
4a	H	H	255–257	9	56
4b	H	4-Me	246–247	10	50
4c	4-Me	H	215–217	9	55
4d	4-Me	4-Me	226–227	10	50
4e	4-Me	4-Cl	241–242	8	70
4f	4-Me	4-NO_2	242–243	8	65
4g	4-Cl	H	236–237	10	55
4h	4-Cl	4-Me	259–260	11	62
4i	3,4-OMe	H	193–195	10	55
4j	3,4-OMe	4-Cl	188–189	9	65
4k	3,4-OMe	4-OMe	183–184	10	60

compound **1a** (1.0 equiv) with 1.0 equiv of benzaldehyde **3a,** 1.0 equiv of ethyl chloroacetate, and 1.0 equiv of NaOAc in ethanol gave the desired product **4a** in 10% yield (Table 1, entry 1). For optimizing the reaction conditions, different bases and ratios of bases were compared. With the optimized conditions in hand, the scope of the reaction was investigated, and the typical results were summarized in Table 1.

To evaluate the generality of the process, several examples illustrating the present procedure for the synthesis of thiazoloquinazolinone derivatives **4** were studied (Table 2). The reaction of compound **1a–d** with various aromatic aldehydes **3a–e** bearing electron-withdrawing groups (such as nitro and halo), electron-releasing groups (such as methyl and methoxy), and ethyl chloroacetate **2** was carried out in the presence of sodium hydride, and it afforded the corresponding products in good yields. On the other hand, aliphatic aldehydes such as propionaldehyde or butyraldehyde and heterocyclic aldehydes such as 2-pyridinecarbaldehyde or furfural were also examined under the same conditions, but the corresponding products were isolated only in trace amounts.

Two isomeric products may be expected for this reaction. The *Z* configuration of the exocyclic C=C bond, in the 2-benzylidene derivatives **4a–k**, was attributed on the basis of ^{1}H NMR spectral analysis. The methine proton resonated, as expected, at higher chemical shift values, due to the deshielding effect of the adjacent C=O, than it would do in *E* isomers, because of the lower deshielding effect of 1-S.[20,21]

^{1}H NMR spectra of all synthesized compounds reveal a singlet signal at low field shift due to the resonance of the vinyl proton. The aliphatic protons relative to the pyrimidine ring appear at δ 6.20. The IR spectra of compounds **4a–k** show absorptions at 1700 and 1650 cm^{-1}, characteristic of the carbonyl group.

CONCLUSION

In conclusion, we have described a simple, efficient, and one-pot synthesis for preparation of thiazoloquinazolinone derivatives in three-component condensation reactions of aldehydes, ethyl chloroacetate, and thioxoquinazolinone in present NaH. In addition to the efficiency and simplicity provided, this protocol describes good yields of cyclization and simple purification for these products.

EXPRIMENTAL

Melting points were determined using an electrothermal digital melting point apparatus and are uncorrected. IR spectra were prepared on a galaxy series FT-IR 5000 spectrophotometer using KBr discs. NMR spectra were recorded on a Brucker spectrophotometer (300 MHz) in $CDCl_3$ using TMS as an internal standard. Elemental analyses were performed by Vario EL equipment at Arak University.

General Procedure for Preparation of 4a–k

A solution of thioxoquinazolinone **1a-d** (0.2 mmol), sodium hydride (0.3 mmol), ethyl chloroacetate (0.3 mmol), and the appropriate aromatic aldehyde **3a–e** (0.2 mmol) in ethanol (10 mL) was refluxed for a predetermined time. The progress of the reaction was monitored by TLC. The reaction mixture was cooled to give a precipitate, which was then filtered and washed with cold ethanol. The compound obtained was dried and crystallized from ethanol, giving the pure products **4a–k**.

(*Z*)-2-Benzylidene-8,8-dimethyl-5-phenyl-8,9-dihydro-2H-thiazolo[2,3-b]quinazoline-3,6(5H,7H)-dione 4a

FT-IR (KBr): $\nu = 3055$ ($CH_{arom.}$), 2868 ($CH_{aliph.}$), 1712 (C=O), 1658 (C=O), 1548 (C=N) cm^{-1}; ^1H NMR ($CDCl_3$): $\delta = 1.04$ (s, 3H, CH_3), 1.13 (s, 3H, CH_3), 2.24 (d, $J =$ 16.3 Hz, 1H, CH_2−C=C), 2.31(d, $J = 16.5$ Hz, 1H, CH_2−C=C), 2.58 (d, $J = 18.0$ Hz, 1H, CH_2−C=O), 2.67 (d, $J = 18.2$ Hz, 1H, CH_2−C=O), 6.24 (s, 1H, $H_{Pyrimidine}$), 7.24–7.33 (m, 3H, $H_{arom.}$), 7.42–7.78 (m, 7H, $H_{arom.}$), 7.80 (s, 1H, H_{vinyl}); ^{13}C NMR ($CDCl_3$): $\delta =$ 27.8 (CH_3), 29.0 (CH), 44.8 (CH_2), 50.9 (CH_2), 53.9 (C-5), 115.2, 119.5, 127.8, 128.6, 128.7, 129.3, 130.2, 130.8, 133.0, 134.6, 140.0, 155.6, 159.7 (C=N), 165.0 (N−C=O), 195.9 (C=O); $C_{25}H_{22}N_2O_2S$: C, 72.44; H, 5.35; N, 6.76; S, 7.74. Found: C, 72.29; H, 5.22; N, 6.60; S, 7.68.

(*Z*)-8,8-Dimethyl-2-(4-methylbenzylidene)-5-phenyl-8,9-dihydro-2H-thiazolo[2,3-b]quinazoline-3,6(5H,7H)-dione 4b

FT-IR (KBr): $\nu = 2866$ ($CH_{arom.}$), 1710 (C=O), 1656 (C=O), 1550 (C=N) cm^{-1}; ^1H NMR ($CDCl_3$) $\delta = 1.04$ (s, 3H, CH_3), 1.13 (s, 3H, CH_3), 2.24 (d, $J = 16.4$ Hz, 1H, CH_2−C=C), 2.31 (d, $J = 16.3$ Hz, 1H, CH_2−C=C), 2.42 (s, 3H, CH_3), 2.59 (d, $J = 18.2$ Hz, 1H, CH_2−C=O), 2.68 (d, $J = 18.1$ Hz, 1H, CH_2−C=O), 6.24 (s, 1H, $H_{Pyrimidine}$), 7.27–7.45 (m, 9H, $H_{arom.}$), 7.81 (s, 1H, H_{vinyl}); ^{13}C NMR ($CDCl_3$ $_6$): $\delta = 21.7$ (CH_3), 27.7 (CH_3), 29.0 (CH_3), 32.7(CH), 45.0 (CH_2), 50.9 (CH_2), 53.8 (C-5), 115.1, 118.4, 127.3, 128.6, 128.7, 130.1, 130.2, 134.4, 139.9, 141.6, 156.1 (C=N), 159.6, 165.2 (N−C=O), 195.9 (C=O); $C_{26}H_{24}N_2O_2S$: C, 72.87; H, 5.64; N, 6.54; S, 7.48. Found: C, 72.61; H, 5.55; N, 6.42; S, 7.39.

(*Z*)-2-Benzylidene-8,8-dimethyl-5-p-tolyl-8,9-dihydro-2H-thiazolo[2,3-b]quinazoline-3,6(5H,7H)-dione 4c

FT-IR (KBr): $\nu = 3047$ ($CH_{arom.}$), 2955 ($CH_{aliph.}$), 1716 (C=O),1656 (C=O), 1547 (C=N) cm^{-1}; ^1H NMR ($CDCl_3$) $\delta = 1.06$ (s, 3H, CH_3), 1.14 (s, 3H, CH_3), 2.28 (s, 3H, CH_3), 2.30 (s, 2H, CH_2−C=C), 2.62 (d, $J = 17.9$ Hz, 1H, CH_2−C=O), 2.72 (d,

$J = 18.1$ Hz, 1H, CH_2—C=O), 6.23 (s, 1H, $H_{Pyrimidine}$), 7.11–7.15 (m, 2H, $H_{arom.}$), 7.33 (d, $J = 7.7$ Hz, 2H, $H_{arom.}$), 7.50 (s, 5H, $H_{arom.}$), 7.84 (s, 1H, H_{vinyl}); ^{13}C NMR ($CDCl_3$): $\delta =$ 21.2 (CH_3), 27.7 (CH_3), 29.0 (CH_3), 32.8(CH), 44.7 (CH_2), 50.9(CH_2), 53.7 (C-5), 115.2, 119.6, 127.7, 129.3, 130.1, 130.8, 133.0, 134.5, 136.8, 138.2, 153.6, 159.6 (C=N), 165.1 (N—C=O), 195.9 (C=O); $C_{26}H_{24}N_2O_2S$: C, 72.87; H, 5.64; N, 6.54; S, 7.48. Found: C, 72.71; H, 5.59; N, 6.48; S, 7.36.

(*Z*)-8,8-Dimethyl-2-(4-methylbenzylidene)-5-p-tolyl-8,9-dihydro-2H-thiazolo[2,3-b]quinazoline-3,6(5H,7H)-dione 4d

FT-IR (KBr): $v = 3038$ ($CH_{arom.}$), 2966 ($CH_{aliph.}$), 1710 (C=O),1651(C=O), 1539 (C=N) cm^{-1}; ^{1}H NMR ($CDCl_3$): $\delta = 1.05$ (s, 3H, CH_3), 1.13 (s, 3H, CH_3), 2.29 (s, 5H, CH_2—C=C and CH_3), 2.42 (s, 3H, CH_3), 2.63 (s, 2H, CH_2—C=O), 6.20 (s, 1H, $H_{Pyrimidine}$), 7.12 (d, $J = 6.6$ Hz, 2H, $H_{arom.}$), 7.28–7.34 (m, 4H, $H_{arom.}$), 7.39 (d, $J = 6.9$ Hz, 2H, $H_{arom.}$), 7.77 (s, 1H, H_{vinyl}); ^{13}C NMR ($CDCl_3$): $\delta = 21.2$ (CH_3), 21.7 (CH_3), 27.7 (CH_3), 29.0 (CH_3), 32.8 (CH), 44.5 (CH_2), 50.9 (CH_2), 53.7 (C-5), 115.1, 118.1, 127.7, 129.4, 130.1, 130.3, 135.2, 136.7, 138.6, 141.8, 155.0, 160.1 (C=N), 165.0 (N—C=O), 195.8 (C=O); $C_{27}H_{26}N_2O_2S$: C, 73.27; H, 5.92; N, 6.33; S, 7.25. Found: C, 73.11; H, 5.80; N, 6.26; S, 7.19.

(*Z*)-2-(4-Chlorobenzylidene)-8,8-dimethyl-5-p-tolyl-8,9-dihydro-2H-thiazolo[2,3-b]quinazoline-3,6(5H,7H)-dione 4e

FT-IR (KBr): $v = 3040$ ($CH_{arom.}$), 2939–2866 ($CH_{aliph.}$), 1710 (C=O),1651(C=O), 1548 (C=N) cm^{-1}; ^{1}H NMR ($CDCl_3$): $\delta = 1.06$ (s, 3H, CH_3), 1.14 (s, 3H, CH_3), 2.22–2.34 (m, 5H, CH_2—C=C and CH_3), 2.61 (d, $J = 18.1$ Hz, 1H, CH_2—C=O), 2.70 (d, $J = 18.0$ Hz, 1H, CH_2—C=O), 6.21 (s, 1H, $H_{Pyrimidine}$), 7.10–7.14 (m, 2H, $H_{arom.}$), 7.32 (d, $J = 7.9$ Hz, 2H, $H_{arom.}$), 7.42 (d, $J = 8.8$ Hz, 2H, $H_{arom.}$), 7.47 (d, $J = 8.8$ Hz, 2H, $H_{arom.}$), 7.60 (s, 1H, H_{vinyl}). ^{13}C NMR ($CDCl_3$): $\delta = 21.2$ (CH_3), 27.7 (CH_3), 29.3 (CH_3), 32.7 (CH), 44.8 (CH_2), 50.9 (CH_2), 53.8 (C-5), 115.3, 120.4, 128.9, 129.4, 129.6, 131.2, 131.6, 132.6, 136.7, 136.8, 138.5, 155.6, 158.8 (C=N), 164.9 (N—C=O), 195.9 (C=O); Anal.calcd for $C_{26}H_{23}ClN_2O_2S$: C, 67.45; H, 5.01; N, 6.05; S, 6.93. Found: C, 67.20; H, 4.87; N, 5.92; S, 6.81.

(*Z*)-8,8-Dimethyl-2-(4-nitrobenzylidene)-5-p-tolyl-8,9-dihydro-2H-thiazolo[2,3-b]quinazoline-3,6(5H,7H)-dione 4f

FT-IR (KBr): $v = 3033$ ($CH_{arom.}$), 2962–2868 ($CH_{aliph.}$), 1714 (C=O),1647 (C=O), 1554 (C=N) cm^{-1}; ^{1}H NMR ($CDCl_3$): $\delta = 1.06$ (s, 3H, CH_3), 1.14 (s, 3H, CH_3), 2.29 (b, 2H, CH_2—C=C), 2.30 (s, 3H, CH_3), 2.60 (d, $J = 18.4$ Hz, 1H, CH_2—C=O), 2.70 (d, $J =$ 18.4 Hz, 1H, CH_2—C=O), 6.21 (s, 1H, $H_{Pyrimidine}$), 7.13 (t, $J = 6.5$ Hz, 2H, $H_{arom.}$), 7.32 (d, $J = 7.8$ Hz, 2H, $H_{arom.}$), 7.65 (d, $J = 8.4$ Hz, 2H, $H_{arom.}$), 7.80 (s, 1H, H_{vinyl}), 8.34 (d, $J = 8.4$ Hz, 2H, $H_{arom.}$). ^{13}C NMR ($CDCl_3$): $\delta = 21.2$ (CH_3), 27.7 (CH_3), 29.0 (CH_3), 32.8 (CH), 44.5 (CH_2), 50.9 (CH_2), 54.0 (C-5), 115.6, 124.3, 124.5, 127.7, 129.5, 130.5, 130.9, 136.3, 138.8, 139.1, 148.0, 154.9, 158.1 (C=N), 164.4 (N—C=O), 195.9 (C=O); Anal.calcd for $C_{26}H_{23}N_3O_4S$: C, 65.94; H, 4.90; N, 8.87; S, 6.77. Found: C, 65.68; H, 4.79; N, 8.68; S, 6.51.

(*Z*)-2-Benzylidene-5-(4-chlorophenyl)-8,8-dimethyl-8,9-dihydro-2H-thiazolo[2,3-b]quinazoline-3,6(5H,7H)-dione 4g

FT-IR (KBr): $\nu = 3051$ ($CH_{arom.}$), 2868 ($CH_{aliph.}$), 1714 (C=O),1658 (C=O), 1539 (C=N) cm^{-1}; ^1H NMR ($CDCl_3$): $\delta = 1.05$ (s, 3H, CH_3), 1.14 (s, 3H, CH_3), 2.25 (d, $J =$ 16.9 Hz, 1H, CH_2−C=C), 2.32 (d, $J = 17.2$ Hz, 1H, CH_2−C=C), 2.56–2.70 (m, 2H, CH_2−C=O), 6.21 (s,1H, $H_{Pyrimidine}$), 7.29 (d, $J = 8.7$ Hz, 2H, $H_{arom.}$), 7.38 (d, $J = 7.9$ Hz, 2H, $H_{arom.}$), 7.50 (s, 5H, $H_{arom.}$), 7.83 (s,1H, H_{vinyl}); ^{13}C NMR ($CDCl_3$): $\delta = 27.7$ (CH_3), 29.1 (CH_3), 32.7 (CH), 44.8 (CH_2), 50.8 (CH_2), 53.3 (C-5), 114.8, 119.4, 128.9, 129.1, 129.3, 130.2, 130.8, 132.9, 134.5, 134.7, 138.3, 156.0, 159.5 (C=N), 165.0 (N−C=O), 195.8 (C=O); Anal.calcd for $C_{25}H_{21}ClN_2O_2S$: C, 66.88; H, 4.71; N, 6.24; S, 7.14. Found: C, 66.64; H, 4.62; N, 6.03; S, 6.98.

(*Z*)-5-(4-Chlorophenyl)-8,8-dimethyl-2-(4-methylbenzylidene)-8,9-dihydro-2H-thiazolo[2,3-b]quinazoline-3,6(5H,7H)-dione 4h

FT-IR (KBr): $\nu = 3040$ ($CH_{arom.}$), 2955–2854 ($CH_{aliph.}$), 1710 (C=O),1649 (C=O), 1539 (C=N) cm^{-1}; ^1H NMR ($CDCl_3$): $\delta = 1.04$ (s, 3H, CH_3), 1.14 (s, 3H, CH_3), 2.24 (d, $J = 16.6$ Hz,1H, CH_2−C=C), 2.31 (d, $J = 15.4$ Hz, 1H, CH_2−C=C), 2.43 (s, 3H, CH_3), 2.60 (d, $J = 18.1$ Hz, 1H CH_2−C=O), 2.68(d, $J = 18.2$ Hz, 1H, CH_2−C=O), 6.20 (s, 1H, $H_{Pyrimidine}$), 7.21–7.43 (m, 8H, $H_{arom.}$), 7.80 (s,1H, H_{vinyl}); ^{13}C NMR ($CDCl_3$): $\delta =$ 21.7 (CH_3), 27.7 (CH_3), 29.0 (CH_3), 32.8 (CH), 44.8 (CH_2), 50.8 (CH_2), 53.3 (C-5), 114.6, 118.0, 128.9, 129.1, 129.3, 130.1, 130.3, 134.4, 135.0, 138.4, 141.8, 156.1, 159.7 (C=N), 165.1 (N−C=O), 195.9 (C=O); Anal.calcd for $C_{26}H_{23}ClN_2O_2S$: C, 67.45; H, 5.01; N, 6.05; S, 6.93. Found: C, 67.22; H, 4.88; N, 5.84; S, 6.72.

(*Z*)-2-Benzylidene-5-(3,4-dimethoxyphenyl)-8,8-dimethyl-8,9-dihydro-2H-thiazolo[2,3-b]quinazoline-3,6(5H,7H)-dione 4i

FT-IR (KBr): $\nu = 3044$ ($CH_{arom.}$), 2957–2872 ($CH_{aliph.}$), 1716 (C=O), 1662 (C=O), 1533 (C=N) cm^{-1}; ^1H NMR ($CDCl_3$): $\delta = 1.07$ (s, 3H, CH_3), 1.14 (s, 3H, CH_3), 2.25 (d, $J = 18$ Hz, 1H, CH_2−C=C), 2.32 (d, $J = 18$ Hz, 1H, CH_2−C=C), 2.58 (d, $J = 18.0$ Hz, 1H, CH_2−C=O), 2.66 (d, $J = 17.8$ Hz, 1H, CH_2−C=O), 3.83 (s, 3H, OCH_3), 3.89 (s, 3H, OCH_3), 6.19 (s, 1H, $H_{Pyrimidine}$), 6.79 (d, $J = 8$ Hz, 1H, $H_{arom.}$), 6.9 4 (d, $J = 8.2$ Hz, 1H, $H_{arom.}$), 7.01 (s, 1H, $H_{arom.}$), 7.49 (t, 5H, $H_{arom.}$), 7.81 (s, 1H, H_{vinyl}) . ^{13}C NMR ($CDCl_3$): $\delta = 27.6$ (CH_3), 29.1 (CH_3), 32.8 (CH), 44.4 (CH_2), 50.9 (CH_2), 53.6 (C-5), 55.8 (OMe), 55.9 (OMe), 111.0, 111.3, 115.1, 119.3, 119.9, 129.4, 130.2, 130.9, 132.21, 132.9, 134.9, 148.9, 149.2, 155.2, 159.8 (C=N), 165.0 (N−C=O), 195.9 (C=O); Anal.calcd for $C_{27}H_{26}N_2O_4S$: C, 68.33; H, 5.52; N, 5.90; S, 6.76. Found C, 68.09; H, 5.41; N, 5.74; S, 6.59.

(*Z*)- 2-(4-Chlorobenzylidene)-5-(3,4-dimethoxyphenyl)-8,8-dimethyl-8,9-dihydro-2H-thiazolo[2,3-b]quinazoline-3,6(5H,7H)-dione 4j

FT-IR (KBr): $\nu = 3049$ ($CH_{arom.}$), 2931 ($CH_{aliph.}$), 1716 (C=O),1649 (C=O), 1533 (C=N) cm^{-1}; ^1H NMR ($CDCl_3$): $\delta = 1.07$ (s, 3H, CH_3), 1.13 (s, 3H, CH_3), 2.25 (d, $J =$ 15 Hz, 1H, CH_2−C=C), 2.31 (d, $J = 15$ Hz, 1H, CH_2−C=C), 2.57(d, $J = 18$ Hz, 1H, CH_2−C=O), 2.66 (d, $J = 18$ Hz, 1H, CH_2−C=O), 3.83 (s, 3H, OCH_3), 3.88 (s, 3H, OCH_3), 6.18 (s, 1H, $CH_{Pyrimidine}$), 6.78 (d, $J = 8.3$ Hz, 1H, $H_{arom.}$), 6.93 (d, d, $j = 8.3$, 1.7 Hz, 1H, $H_{arom.}$), 7.01 (d, $J = 1.6$ Hz, 1H, $H_{arom.}$), 7.41 (d, $J = 8.7$ Hz, 2H, $H_{arom.}$), 7.46

(d, $J = 8.6$ Hz, 2H, $H_{arom.}$), 7.74 (s,1H, H_{vinyl}); ^{13}C NMR ($CDCl_3$): $\delta = 27.6$ (CH_3), 29.1 (CH_3), 32.7 (CH), 44.8 (CH_2), 50.8 (CH_2), 53.6 (C-5), 55.8 (OMe), 55.9 (OMe), 110.9, 111.3, 115.2, 119.9, 120.3, 129.6, 131.2, 131.5, 132.3, 132.7, 136.7, 148.8, 149.2, 155.7, 158.8(C=N), 164.9 (N−C=O), 196.0 (C=O); Anal.calcd for $C_{27}H_{25}ClN_2O_4S$: C, 63.71; H, 4.95; N, 5.50; S, 6.30. Found: C, 63.50; H, 4.86; N, 5.38; S, 6.14.

(*Z*)-5-(3,4-Dimethoxyphenyl)-2-(4-methoxybenzylidene)-8,8-dimethyl-8,9-dihydro-2H-thiazolo[2,3-b]quinazoline-3,6(5H,7H)-dione 4k

FT-IR (KBr): $v = 3033$ ($CH_{arom.}$), 2931–2835 ($CH_{aliph.}$), 1707 (C=O), 1651 (C=O), 1523 (C=N) cm^{-1}; ^1H NMR ($CDCl_3$): $\delta = 1.07$ (s, 3H, CH_3), 1.14 (s, 3H, CH_3), 2.26 (d, $J = 15.3$ Hz, 1H, CH_2−C=C), 2.32(d, $J = 15.1$ Hz, 1H, CH_2−C=C), 2.64 (br, 2H, CH_2−C=O), 3.83 (s, 3H, OCH_3), 3.88 (s, 6H, $2OCH_3$), 6.19 (s, 1H, $H_{Pyrimidine}$), 6.78(d, $J = 7.9$ Hz, 1H, $H_{arom.}$), 6.93 (d, $J = 6.8$ Hz, 1H, $H_{arom.}$), 7.01(t, 3H, $H_{arom.}$), 7.47(d, $J = 8.4$, 2H, $H_{arom.}$), 7.78 (s, 1H, H_{vinyl}); ^{13}C NMR ($CDCl_3$): $\delta = 27.6$ (CH_3), 29.2 (CH_3), 32.7 (CH), 44.9 (CH_2), 50.9 (CH_2), 53.4 (C-5), 55.5 (OMe), 55.8 (OMe), 55.9 (OMe), 110.9, 111.2, 114.9, 116.6, 119.9, 125.7, 132.2, 132.7, 134.3, 148.8, 149.1, 156.1, 159.7, 161.6, 165.4 (N−C=O), 196.0 (C=O); Anal.calcd for $C_{28}H_{28}N_2O_5S$: C, 66.65; H, 5.59; N, 5.55; S, 6.35. Found: C, 66.51; H, 5.49; N, 5.46; S, 6.22.

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