Synthesis of Some Novel N\textsuperscript{7}-tetrazolo[5,1-\textit{f}]-1,2,4-triazin-8-(7\textit{H})-one Compounds as Potential Antimicrobial Agents

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ABSTRACT. A series of new N\textsuperscript{7}-tetrazolo[5,1-\textit{f}]-1,2,4-triazin-8-(7\textit{H})-one derivatives 4–16 were designed and synthesized from 3 with different reagents. The newly prepared compounds were characterized by spectral data and screened for their antimicrobial activities against various bacteria and fungi strains.

Key words: Tetrazolo[5,1-\textit{f}]-1,2,4-triazin-8-(7\textit{H})-one, Synthesis, Structure elucidation, Biological assay

INTRODUCTION

The tetrazole nucleus of several compounds has been published of different heterocyclic rings.\textsuperscript{1–8} Numerous biological properties have been reported for tetrazolo-heterocycles, such as being useful due to their antibacterial,\textsuperscript{9,10} antiproliferation,\textsuperscript{10} anticancer,\textsuperscript{10} and anticonvulsant\textsuperscript{11} activities. Various reviews,\textsuperscript{12–14} dealing with the synthesis of condensed 1,2,4-triazine moiety plays a vital role in many biological activities including antiviral,\textsuperscript{15} antihypertensive,\textsuperscript{16,17} blood-platelet aggregation inhibitory,\textsuperscript{16,17} analgesic,\textsuperscript{18} and antibacterial properties,\textsuperscript{19,20} as well as some of new anti-HIV and anticancer agents.\textsuperscript{21} In report here high yield synthetic procedures for the preparation of the title compounds and their full characterization data.

EXPERIMENTAL

Melting points were determined in open glass capillaries on a Buchi-530 melting point apparatus an are uncorrected. Spectroscopic data were recorded on the following instruments: Infrared (IR) spectra (KBr; $\gamma$ cm\textsuperscript{-1}) Perkin Elimer 1240 spectrophotometer, nuclear magnetic resonance ($\gamma$ H NMR) spectra (Chemical shift, $\delta$ ppm) varion Mercury (300 MHz) spectrometer using TMS as internal standard and electron impact. Mass spectra (El-Ms) GC-MS (QP/000EX) Shimadzu spectrometer at an ionizing voltage of 70 ev. Reaction progress and purity of the compounds were checked by TLC, making use of Silica Gel plates F254 on Aluminum sheets. Elemental analyses were performed by the Microanalytical center of Cairo University.

N\textsuperscript{7}-Potassium salt tetrazolo[5,1-\textit{f}]-1,2,4-triazin-8-(7\textit{H})-one 3

Compound 2, 2 mmol was disolvesed in 20 cm\textsuperscript{3} of abs. ethanol and treated with alcoholic potassium hydroxide solution (0.12 g, 2 mmol). The mixture was stirred for 2 h and the potassium salt 3 was filtered washed with abs. ethanol and dried, yield: 0.28 g (73%); m.p. >300 $^\circ$C.

N\textsuperscript{7}-(2-Oxopropyl)tetrazolo[5,1-\textit{f}]-1,2,4-triazin-8-(7\textit{H})-one 4

A mixture of (3, 2 mmol) and chloroacetone (2 mmol) in dimethylformamide (15 cm\textsuperscript{3}) was refluxed for 3 h. The reaction mixture was filtered under hot, concentrated and the obtained solid was crystallized from abs. ethanol, and dried, yield: 0.22 g (66%); m.p. 180–182 $^\circ$C; IR (KBr): $\gamma$ = 1750 (CO), 1680 (CO, aromatic), 1620 (CN) cm\textsuperscript{-1}; $\gamma$ H NMR (DMSO-d\textsubscript{6}): $\delta$ = 8.22 (s, 1H, CH triazine ring), 5.21 (s, 2H, CH\textsubscript{2}), 1.62 (s, 3H, CH\textsubscript{3}) ppm; MS: m/z (%) = 194 (M\textsuperscript{+}, 20). Anal. Calcd. for C\textsubscript{8}H\textsubscript{12}N\textsubscript{2}O\textsubscript{2} (194): C: 37.11; H: 3.09; N, 43.29. Found: C, 37.15; H, 3.21; N, 42.99.

N\textsuperscript{7}-(Ethoxycarbonylmethyl)tetrazolo[5,1-\textit{f}]-1,2,4-triazin-8-(7\textit{H})-one 5

Compound 5 was prepared from (3, 2 mmol) and ethylchloroacetate (2 mmol) as just described for the preparation of 4. It was crystallized from abs. ethanol, and dried, yield: 0.29 g (76%); m.p. 151–152 $^\circ$C IR (KBr): $\gamma$ = 1765 (CO), 1685 (CO, aromatic), 1620 (CN) cm\textsuperscript{-1}; $\gamma$ H NMR (DMSO-d\textsubscript{6}): $\delta$ = 8.44 (s, 1H, CH triazine ring), 5.20 (s, 2H, CH\textsubscript{2}), 4.21 (q, 2H, CH\textsubscript{2}CH\textsubscript{3}), 1.31 (t, 3H, CH\textsubscript{2}CH\textsubscript{3}) ppm; MS: m/z (%) = 225 (M\textsuperscript{+} + 1, 30). Anal. Calcd. for C\textsubscript{10}H\textsubscript{14}N\textsubscript{2}O\textsubscript{2} (224): C,
N\textsuperscript{2}-(Hydrazinocarboxamymethyl)tetrazolo[5,1-\textbeta]-1,2,4-triazin-8-(7H)-one 6

To a solution of (5, 1 mmol) in abs. ethanol (30 cm\textsuperscript{3}), hydrazine hydrate (1 mmol) was added and the reaction mixture was heated under stirring for 2 h. After cooling the separated product was filtered and crystallized from abs. ethanol, and dried, yield: 0.20 g (71%); m.p. 215

N\textsuperscript{2}-(3-Methyl-5-oxopyrazolidin-1-ylcarbonylmethyl]tetrazolo[5,1-\textbeta]-1,2,4-triazin-8-(7H)-one 8

A mixture of (6, 1 mmol) and acetylacetone (1 mmol) in abs. ethanol (15 cm\textsuperscript{3}) was heated at 90°C on water-bath for 3 h. The reaction mixture was cooled, poured onto water and the formed precipitate was filtered and crystallized from ethanol, and dried, yield: 0.28 g (71%); m.p. 200

N\textsuperscript{2}-(5-Thioxo-4-phenyl-1,2,4-triazin-3-ylmethyl]tetrazolo[5,1-\textbeta]-1,2,4-triazin-8-(7H)-one 10

The thiocarbamate (9, 1 mmol) was refluxed in (15 cm\textsuperscript{3}) of sodium hydroxide (0.34 g) solution for 2 h, filtered after cooling and acidified with 2 N hydrochloric acid. The precipitated of the crude product was filtered, washed several times with cold water and crystallized from abs. ethanol, and dried, yield: 0.22 g (71%); m.p. 260

General Procedure for the Synthesis of Arylbenzylidenes 12a–c

A mixture of the acetic acid hydrazide (6, 1 mmol) and an appropriate aromatic aldehyde (1 mmol) namely, benzaldehyde, p-methylbenzaldehyde or p-nitrobenzaldehyde was refluxed in 20 cm\textsuperscript{3} abs. ethanol for 3 h. After cooling the separated solid was collected by filtration, dried and crystallized from absolute ethanol. The physico-chemical and spectral data of 12a–c the following:

N\textsuperscript{2}-(2-Benzylidenecetohydrazide)tetrazolo[5,1-\textbeta]-1,2,4-triazin-8-(7H)-one 12a:

Yield: 0.33 g (78%); m.p.: 175–177 °C; IR (KBr): \(\gamma = \)
3188 (NH), 1680 (CO, aromatic), 1665 (CO, amidic), 1615 (C=N) cm\(^{-1}\); \(^1\)H NMR (DMSO-\(d_6\)): \(\delta = 9.30\) (s, 1H, NH, exchangeable with D\(_2\)O), 9.22 (s, 1H, CH=\(\equiv\)N), 9.02 ppm; MS: \(m/z (%) = 299\) (M\(^+\) + 1, 17). Anal. Calcd. for C\(_{12}\)H\(_6\)N\(_2\)O\(_2\): C, 50.96; H, 2.55; N, 36.51. Found: C, 51.22; H, 2.44; N, 37.88.

\(\text{N}^2\)-[2-(p-Methylbenzyldeneacetohydrazide)]tetrazolo [5,1-f]-1,2,4-triazin-8-(7H)-one 12b:

Yield: 0.22 g (52%); m.p. 153–155 °C; \(^1\)H NMR (DMSO-\(d_6\)): \(\delta = 9.35\) (s, 1H, NH, exchangeable with D\(_2\)O), 9.20 (s, 1H, CH=\(\equiv\)N), 9.16 ppm; MS: \(m/z (%) = 324\) (M\(^+\) + 1, 10). Anal. Calcd. for C\(_{12}\)H\(_6\)N\(_2\)O\(_2\): C, 50.96; H, 2.55; N, 36.51.

General Procedure for the Synthesis of 5-Aryl-1,3,4-oxadiazoles 13a–c

A mixture of the appropriate (12a–c, 1 mmol) and acetic anhydride (15 cm\(^3\)) was heated under reflux for 4 h. The reaction mixture was cooled, poured onto ice-water and allowed to stand at ambient temperature. The solid product was collected and recrystallized from abs. ethanol to afford the product. The physico-chemical and spectral data of 13a–c the following:

\(\text{N}^2\)-[2-(p-Nitrobenzyldeneacetohydrazide)]tetrazolo [5,1-f]-1,2,4-triazin-8-(7H)-one 12c:

Yield: 0.35 g (83%); m.p. 178–180 °C; IR (KBr): \(\gamma = 3180\) (NH), 1690 (CO, aromatic), 1660 (CO, amidic), 1620 (C=N) cm\(^{-1}\); MS: \(m/z (%) = 354\) (M\(^+\) + 1, 10). Anal. Calcd. for C\(_{12}\)H\(_6\)N\(_2\)O\(_2\): C, 50.96; H, 2.55; N, 36.51.

Yield: 0.19 g (55%); m.p.: 140–142 °C; IR (KBr): \(\gamma = 1760\) (CO), 1680 (CO, aromatic), 1625 (C=N) cm\(^{-1}\); \(^1\)H NMR (DMSO-\(d_6\)): \(\delta = 8.12–7.30\) (m, 5H, CH triazine ring + 4 \(ArH\)), 5.14 (2H, CH\(_2\)), 2.10 (s, 1H, CH oxadiazole ring), 2.30, 2.12, (2s, 3H each, 2CH\(_3\)) ppm; MS: \(m/z (%) = 355\) (M\(^+\) + 1, 10). Anal. Calcd. for C\(_{12}\)H\(_6\)N\(_2\)O\(_2\): C, 50.84; H, 3.95; N, 31.63. Found: C, 51.22; H, 4.24; N, 31.42.

Yield: 0.19 g (55%); m.p.: 140–142 °C; IR (KBr): \(\gamma = 1760\) (CO), 1680 (CO, aromatic), 1625 (C=N) cm\(^{-1}\); \(^1\)H NMR (DMSO-\(d_6\)): \(\delta = 8.12–7.30\) (m, 5H, CH triazine ring + 4 \(ArH\)), 5.14 (2H, CH\(_2\)), 2.10 (s, 1H, CH oxadiazole ring), 2.30, 2.12, (2s, 3H each, 2CH\(_3\)) ppm; MS: \(m/z (%) = 355\) (M\(^+\) + 1, 10). Anal. Calcd. for C\(_{12}\)H\(_6\)N\(_2\)O\(_2\): C, 50.84; H, 3.95; N, 31.63. Found: C, 51.22; H, 4.24; N, 31.42.

\(\text{N}^2\)-[2-Thioxo-2,3-dihydro-1,3,4-oxadiazol-5-ymlmethyl]tetrazolo [5,1-f]-1,2,4-triazin-8-(7H)-one 14:

To a mixture of (6, 1 mmol) in abs. ethanol (15 cm\(^3\)) was added of potassium hydroxide (0.10 g) in abs. ethanol (20 cm\(^3\)). Then, carbon disulfide (10 cm\(^3\)) was added portion wise and the reaction mixture was refluxed till no color of hydrogen sulphide evolved. The solid prouduct obtained after cooling and acidification with dilute hydrochloric acid was collected by filtration and recrystallized from abs. ethanol (yellow color), dried, yield: 0.27 g (75%); m.p. 152–154 °C, IR (KBr): \(\gamma = 3295\) (NH), 1690 (CO, aromatic), 1220 (CS) cm\(^{-1}\); \(^1\)H NMR (DMSO-\(d_6\)): \(\delta = 10.86\) (s, 1H, NH, exchangeable with D\(_2\)O), 8.50 (s, 1H, CH triazine ring), 5.29 (s, 2H, CH\(_2\)) ppm; MS: \(m/z (%) = 252\) (M\(^+\) + 12). Anal. Calcd. for C\(_{12}\)H\(_6\)N\(_2\)OS (252): C, 28.87; H, 1.58; N, 44.44. Found: C, 28.34; H, 2.01; N, 44.49.

\(\text{N}^2\)-[2-Amino-5-thioxo-4,5-dihydro-1H-1,2,4-triazol-3-ylmethyl]tetrazolo [5,1-f]-1,2,4-triazin-8-(7H)-one 15:

A mixture of (14, 1 mmol) and hydrazine hydrate (1 mmol) in 15 cm\(^3\) abs. ethanol was refluxed for 2 h. The solvents were removed under reduced pressure, the residue was washed with ether then recrystallized from abs. ethanol, and dried, yield: 0.18 g (58%); m.p. 144–146 °C; IR (KBr): \(\gamma = 3300, 3290\) (NH\(_2\)), 3230 (NH), 1680 (CO, aromatic) cm\(^{-1}\); \(^1\)H NMR (DMSO-\(d_6\)): \(d = 11.20\) (s, 1H, NH exchangeable with D\(_2\)O), 8.30 (s, 1H, CH triazine ring), 5.29 (2H, NH\(_2\), exchangeable with D\(_2\)O), 4.95 (s, 2H, CH\(_2\)) ppm; MS: \(m/z (%) = 266\) (M\(^+\) + 10). Anal. Calcd. for C\(_{12}\)H\(_6\)N\(_2\)O\(_2\) (266): C, 27.06; H, 2.25; N, 52.63. Found: C, 27.22; H, 2.44; N, 52.41.
General Procedure for the Synthesis of Schiff’s Bases 16a–c
A mixture of (15, 1 mmol) and an appropriate aromatic aldehyde (1 mmol) namely, benzenaldehyde, p-methylbenzenaldehyde, or p-nitrobenzenaldehyde (1 mmol) was refluxed in 20 cm$^3$ abs. ethanol for 3 h. After cooling the separated solid was collected by filtration, dried and crystallized from abs. ethanol. The physico-chemical and spectra data of 16a–c the following:

$N_7$-[(4-Benzylideneamino)-5-thioxo-4,5-dihydro-1H-1,2,4-triazol-3-yl-methyl)]-tetrazolo[5,1-f]-1,2,4-triazin-8-(7H)-one 16a:
Yield: 0.29 g (74%); m.p. 160–162 °C; IR (KBr): $\gamma$ = 3195 (NH), 1675 (CO, aromatic) cm$^{-1}$; $^1$H NMR (DMSO-d$_6$): $\delta$ = 10.95 (s, 1H, NH, exchangeable with D$_2$O), 9.51 (s, 1H, CH=N), 8.52–8.30 (m, 5H, ArH), 8.20 (s, 1H, CH triazine ring), 4.85 (s, 2H, CH$_2$) ppm; Ms: m/z (%) = 355 (M$^+$ + 1, 13). Anal. Calcd. for C$_{13}$H$_{10}$N$_7$O$_{10}$S (354): C: 44.06; H, 2.82; N, 39.54. Found: C, 45.21; H, 3.01; N, 39.42.

$N_7$-[(4-p-Methylbenzylideneamino)-5-thioxo-4,5-dihydro-1H-1,2,4-triazol-3-yl-methyl)]-tetrazolo[5,1-f]-1,2,4-triazin-8-(7H)-one 16b:
Yield: 0.24 g (58%); m.p. 135–137 °C; IR (KBr): $\gamma$ = 3240 (NH), 1680 (CO, aromatic) cm$^{-1}$; MS: m/z (%) = 368 (M$^+$ + 1, 7). Anal. Calcd. for C$_{14}$H$_{12}$N$_7$O$_{10}$S (368): C: 45.65; H, 3.26; N, 38.04. Found: C, 45.71; H, 3.42; N, 38.21.

$N_7$-[(4-p-Nitrobenzylideneamino)-5-thioxo-4,5-dihydro-1H-1,2,4-triazol-3-yl-methyl)]-tetrazolo[5,1-f]-1,2,4-triazin-8-(7H)-one 16c:
Yield: 0.39 g (86%); m.p. 177–178 °C; IR (KBr): $\gamma$ = 3240 (NH), 1690 (CO, aromatic) cm$^{-1}$; MS: m/z (%) = 400 (M$^+$ + 1, 12). Anal. Calcd. for C$_{13}$H$_9$N$_{11}$O$_3$S (399): C, 39.09; H, 2.25; N, 38.59. Found: C, 39.22; H, 2.44; N, 38.24.

RESULTS AND DISCUSSION
The structure of the prepared compounds was elucidated using IR, $^1$H NMR, and mass spectroscopic methods besides elemental analyses. The pathways leading to the products obtained have been depicted in Schemes 1, 2, and 3.

Ethyl 1-aminotetrazole-5-carboxylate [2] (1) was reacted with formamide yielded tetrazolo[5,1-f]-1,2,4-triazin-8-(7H)-one [2] (2) which upon treatment with potassium hydroxide afforded the potassium salt 3. Reaction of 3 with chloroacetone and ethyl chloroacetate in dimethylformamide afforded N$^7$-oxopropyl and N$^7$-ethyloxycarbonyl-methyl derivatives 4 and 5, respectively. N$^7$-Hydrazino-carbonylmethyl 6 was synthesized from the ester 5 with hydrazine hydrate in ethanol. The hydrazide 6 revealed
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Scheme 2.

Reagents: i, (CH<sub>3</sub>CO<sub>)</sub>CH<sub>2</sub>; ii, CH<sub>3</sub>COCH<sub>2</sub>COCH<sub>2</sub>CH<sub>3</sub>; iii, PhNCS; iv, NaOH/HCl; v, H<sub>2</sub>SO<sub>4</sub>

Scheme 3.

Reagents: i, ArCHO; ii, (CH<sub>3</sub>CO)<sub>2</sub>O; iii, CS<sub>2</sub>/KOH; iv, N<sub>2</sub>H<sub>4</sub>H<sub>2</sub>O

Ar = a = C<sub>6</sub>H<sub>5</sub>; b = C<sub>6</sub>H<sub>4</sub>-CH<sub>3</sub>(p); c = C<sub>6</sub>H<sub>4</sub>-NO<sub>2</sub>(p)
absorption bands at \( \gamma = 3310, 3270, 3210, 1680 \) and 1660 cm\(^{-1}\) corresponding to \( \text{NHNH}_2 \) and two CO groups. The \(^1\)H NMR spectrum of compound 6 showed \( \delta = 10.20 \) (s, 1H, NH exchangeable with D\(_2\)O), 8.40 (s, 1H, CH triazine ring), 5.10 (s, 2H, CH\(_2\)CO) and 4.40 (s, 2H, NH\(_2\) exchangeable with D\(_2\)O) ppm.

Reaction of the acid hydrazide 6 with acetylacetone and ethyl acetoacetate gave pyrazolyl and pyrazolidinyl structures 7 and 8, respectively. The \(^1\)H NMR spectrum of 7 exhibited, CH pyrazolyl ring and two methyl signals. The IR spectrum of 8 showed characteristic absorption bands at \( \gamma = 1720, 1680 \) and 1675 cm\(^{-1}\) corresponding to three carbonyl amides of pyrazole, triazine and side chain, respectively.

Compound 6 was refluxed with phenylisothiocyanate, the expected N\(^2\)-phenyl-thiocarbamoylhydrazinocarbonylmethyl derivative 9 was resulted, which \(^1\)H NMR spectrum contained characteristic signals to three NH exchangeable with D\(_2\)O and aromatic protons. Alkaline cyclization of the thiocarbamate 9 using sodium hydroxide solution furnished the corresponding 1,2,4-triazolyl nucleus 10, which IR region displayed the disappearance of the two NH and CO absorptions in side chain. The mass spectrum of 10 revealed the molecular ion peak at \( m/z = 327 \). Also, the thiosemicarbazide 9 was cyclized with cold concentrated sulphuric acid caused in the formation of the corresponding 1,3,4-thiadiazolyl derivative 11. The \(^1\)H NMR spectrum of compound 11 showed signals for assigned NH (exchangeable with D\(_2\)O), CH (triazine ring), aromatic protons, and CH\(_2\) group.

Additionally, the condensation of the acetic acid hydrazide 6 with variety of aromatic aldehydes namely, benzaldehyde, p-methylbenzaldehyde and p-nitrobenzaldehyde in absolute ethanol leading to the benzyldenones 12a–c. The \(^1\)H NMR spectra of the latter products showed the methyldiene proton signals and the correct mass spectra. Condensation cyclization of benzyldiene structures 12a–c with acetic anhydride afforded the 4-acetyl-5-aryl-1,3,4-oxadiazole congeners 13a–c. The IR spectra of the latter compounds showed the presence of the absorption bands for carbonyl groups at 1760 or 1740 cm\(^{-1}\) and devoid any bands corresponding NH groups and lacked any NH signals in \(^1\)H NMR spectra.

Cyclocondensation reaction of 6 with carbon disulfide in alcoholic potassium hydroxide, by heating under reflux yielded 1,3,4-oxadiazolyl derivative 14, which showed in IR spectrum NH, CO (aromatic) and CS absorptions and lacked NH\(_2\) and CO (amidic) absorptions characteristic of the parent compound 6. The mass spectrum of 14 revealed a peak corresponding to its molecular ion peak at \( m/z = 252 \). The structure of 14 was inferred chemically its reaction with hydrazine hydrate afforded the amino-1,2,4-triazole derivative 15. The IR spectrum of 15 showed a characteristic absorption bands corresponding to NH\(_2\), NH and CO groups, whereas its mass spectrum showed a peak exhibited to its molecular ion at \( m/z = 266 \).

Furthermore, condensation of 15 with various of aromatic aldehydes namely, benzaldehyde, p-methylbenzaldehyde and p-nitrobenzaldehyde in absolute ethanol afforded the corresponding the expected Schiff’s bases 16a–c which possessed IR absorption characteristic of NH group and lacked NH\(_2\) group. The \(^1\)H NMR spectra of 16a–c revealed signals for assigned NH (exchangeable with D\(_2\)O), methine (CH=\(\text{N}\)), aromatic protons, CH (triazine ring) and CH\(_2\) group.

The antimicrobial activity of the newly synthesized compounds 4–6, 8–10, 12a,c, 13a,c and 14–16a–c were evaluated.

### Table 1. Minimal inhibitory concentration (MIC\(\mu\)g cm\(^{-3}\)) of compounds 4–6, 8–10, 12a,c, 13a,c and 14–16a–c

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<th>Compound</th>
<th>B. subtilis (µg/ml)</th>
<th>S. aureus (µg/ml)</th>
<th>K. pneumoniae (µg/ml)</th>
<th>E. coli (µg/ml)</th>
<th>A. niger (µg/ml)</th>
<th>C. albican (µg/ml)</th>
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against Gram-positive (Bacillus subtilis and Staphylococcus aureus) and Gram-negative (Klebsiella pneumoniae and Escherichia coli) bacteria strains and (Aspergillus niger and Condida albicon) fungi strains. The minimal inhibitory concentration (MIC/mg) cm³ was displayed in Table 1, showing that 5, 13a and 16c exhibited antimicrobial activity against B. subtilis (25%); 6, 8, 9, 13a and 14 against S. aureus (25%); 13c and 14 against K. pneumoniae (50%); 6, 8, 13a and 14 against E. coil (50%) comparable to that of ampicillin. Furthermore, 13c, 14, possessed an antymycotic activity against A. niger (50%) and 6, 8 and 13a against C. albican (50%) comparable to that of clotrimazole.

ANTIMICROBIAL SCREENING

Solutions of the test compounds, ampicillin trihydrate and clotrimazole were prepared in DMSO at a concentration of 100 μg/cm³. Twofold dilution of the compounds were prepared (800, 400, ….. 6.25 g/cm³). The microorganism suspensions at 10⁶ Colony Formin Unit cm³ (CFU/cm³) concentration were inoculated to the corresponding wells. Plates were incubated at 36°C for 24 to 28 h the incubation chamber. The minimal inhibitory concentration (MIC) were determined. Controls with DMSO and infected media were also investigated.

CONCLUSION

In this paper, the synthesis of some novel N²-tetrazolo[5,1-f]-1,2,4-triazin-8(7H)-one compounds 4-16 through potassium salt 3 are described. The antimicrobial activities against various bacteria and fungi strains are screened.

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