CHAPTER-4
Synthesis of 1,2,4-Triazoles and 4-Oxo-1,3-Thiazolidines
4.1 THEORETICAL

The therapeutic effects of 1,2,4-triazole ring has been studied for a number of pathological conditions which include anti-inflammatory, \(^1\), ulcerogenic, \(^2\) ulcerogenic, \(^2\) antibacterial, \(^3\) antibacterial, \(^4\) antibacterial, \(^5\) antifungal, \(^6\) antifungal, \(^7\) and anticancer agents. \(^6\) The scientific literature reveals that these activities are due to the presence of \(-\text{NH-C(S)NH-}\) function in a molecule and change in activity depends upon the nature of the substituents. \(^8\) Oxothiazolidine derivatives have been found to possess antibacterial \(^9\) antibacterial and antitubercular activities. \(^8\) Screening the literature reveals that oxothiazolidines also exhibit antinociceptive, \(^9\) antinociceptive and anti-AIDS (HIV-1) activities. \(^10\)

Reid \(et\ al.\) \(^11\) synthesized 5-substituted-4-amino-3-mercapto-1,2,4-triazoles (118a-d) by cyclizing methyl 3-aroyldithiocarbazates (117a-d) with hydrazine utilizing Hoggarth method.

![Chemical structure](attachment:image.png)

<table>
<thead>
<tr>
<th>Compound</th>
<th>Ar</th>
</tr>
</thead>
<tbody>
<tr>
<td>117a, 118a</td>
<td>C(_6)H(_5)</td>
</tr>
<tr>
<td>117b, 118b</td>
<td>4-FC(_6)H(_4)</td>
</tr>
<tr>
<td>117c, 118c</td>
<td>2-BrC(_6)H(_4)</td>
</tr>
<tr>
<td>117d, 118d</td>
<td>2-CH(_3)OC(_6)H(_4)</td>
</tr>
</tbody>
</table>

Giri \(et\ al.\) \(^12\) reported the formation of 4-phenyl-5-(2,6-dichlorophenyl)-3-mercapto-1,2,4-triazole (120) from thiosemicarbazide (119) in the presence of conc. NaOH.
Synthesis of 3-(α-aryloxypropionyl)-4-aryl-5-mercapto-1,2,4-triazoles (122a-d) from 1-(α-aryloxypropionyl)-4-arylthiosemicarbazides (121a-d) was reported by Srivastava et al.\textsuperscript{13}
1,2,4-Triazoles and 4-Oxy-1,3-thiazolidines

5-(2/4-Anisoxymethyl)-4-aryl-3-mercapto-1,2,4-triazoles (124a,b) were synthesized from 2/4-anisoxacyethyl-4-arylthiosemicarbazides (123a,b) by refluxing in 2N NaOH solution for 2 hrs. 14

\[ R-O-S\overbrace{\text{CH}_2-C-NH-NH-C-NH-R'} \]

\[ 123a,b \]

\[ \begin{array}{c}
R-O-\text{CH}_2-C-NH-NH-C-NH-R' \\
\text{Conc. NaOH} \\
R-O-\text{CH}_2-C-NH-NH-C-NH-R' \\
\text{124a,b}
\end{array} \]

Compound | R | R' |
--- | --- | --- |
123a, 124a | 4-MeO | C\text{\textsubscript{6}}\text{H}\text{\textsubscript{5}} |
123b, 124b | 2-MeO | 4-CH\text{\textsubscript{3}}-C\text{\textsubscript{6}}\text{H}\text{\textsubscript{4}} |

Gawande and Shingare 15 reported that 4-aryl-1-(4-aryl-2-methylthiazole-5-carbonyl)-thiosemicarbazides (125a-c) on cyclization with sod. hydroxide and iodine gave 4-aryl-3-(4-aryl-2-methylthiazol-5-yl)-5-mercapto-1,2,4-triazoles (126a-c).
1,2,4-Triazoles and 4-Oxo-1,3-thiazolidines

<table>
<thead>
<tr>
<th>Compound</th>
<th>R</th>
<th>R’</th>
</tr>
</thead>
<tbody>
<tr>
<td>125a, 126a</td>
<td>H</td>
<td>Br</td>
</tr>
<tr>
<td>125b, 126b</td>
<td>NO₂</td>
<td>Cl</td>
</tr>
<tr>
<td>125c, 126c</td>
<td>H</td>
<td>OMe</td>
</tr>
</tbody>
</table>

1-(4-Substituted-4H-1,2,4-triazole-3-thione-5-yl)methyl-1H-benzotriazoles (128a-c) were synthesized from 4-substituted-1-(1-carbonylmethyl-1H-benzotriazole) thiosemicarbazides (127a-c) by treating it with conc. NaOH.¹⁶

El-Borai et al.¹⁷ proposed the synthesis of 1-H-2-mercapto-5-(2'-thienyl)-1,3,4-triazole (130) from thiosemicarbazide (129) in basic medium.

5-(6'-Nitro benzimidazole-1-ylmethyl)-4-phenyl-3-mercapto-1,2,4-triazole (132) was synthesized from 1-N-(6-nitrobenzimidazole-1-carbonylmethyl)-4-phenyl-3-thiosemicarbazide (131) by Xu et al.¹⁸
Xu et al. further reported synthesis of bis(4-amino-5-mercapto-1,2,4-triazole-3-yl)alkanes (135) by heating thiocarbohydrazide (133) and aliphatic carboxylic acid (134) above their melting point.

4-Allyl-5-aryl-1,2,4-triazoles (138a-d) were synthesized from 1-substituted benzoyl/phenacyl-4-allylthiosemicarbazides (136a-d) by refluxing with 2M NaOH and 4-Allyl/Amino-5-aryl-1,2,4-triazoles (139a-d) were synthesized from
potassium salt of substituted dithiocarbazinic acids (137a-d) by refluxing with hydrazine hydrate followed by acidification with hydrochloric acid.\(^5\)

\[
\begin{align*}
\text{Ar—C—NHNH—C—NHNH—CH}_2\text{CH}=\text{CH}_2 & \quad \text{Ar—C—NHNH—C—S'K}^+ \\
\end{align*}
\]

\[
\begin{align*}
\text{2M NaOH} & \quad \text{HCl} \\
\text{136a-d} & \quad \text{137a-d} \\
\end{align*}
\]

\[
\begin{align*}
\text{Ar—} & \quad \text{N—} \\
\text{N} & \quad \text{S} \\
\text{CH}_2\text{CH}=\text{CH}_2 & \quad \text{NH}_2\text{NH}_2 \\
\text{138a-d} & \quad \text{139a-d} \\
\end{align*}
\]

**Compound**

136a, 137a, 138a, 139a  
136b, 137b, 138b, 139b  
136c, 137c, 138c, 139c  
136d, 137d, 138d, 139d

\[
\begin{align*}
\text{Cansiz et al.}^\text{20} & \quad \text{converted 1-(2-furoyl/phenyl)-4-substituted thiosemicarbazides (140a-d)/(141a-d) into 5-(furan-2-yl/benzyl)-4-(aryl)-4H-1,2,4-triazole-3-thiols (142a-d)/(143a-d) respectively on treatment with 2N NaOH.} \\
\end{align*}
\]

\[
\begin{align*}
\text{140a-d} & \quad \text{141a-d} \\
2\text{N NaOH} & \quad 2\text{N NaOH} \\
\text{142a-d} & \quad \text{143a-d} \\
\end{align*}
\]
1H-4,5-dihydro-3-(3-hydroxy-2-naphthyl)-4-substituted-1,2,4-triazole-5-thiones (145a-d) were synthesized from thiosemicarbazide (144a-d) by refluxing with 2N NaOH followed by treatment with hydrochloric acid.¹

Holla et al.²¹ synthesized 4-amino-5-(6-chloropyridin-3-yl-methyl)-4H-1,2,4-triazole-3-thiol (147) from potassium salt of substituted dithiocarbazinic acids (146) and hydrazine hydrate.
1,2,4-Triazoles and 4-Oxo-1,3-thiazolidinones

3-(4-Methylphenoxy)methyl)-4-phenyl-5-thione-1,2,4-triazole (149) was synthesized from thiosemicarbazide (148) by refluxing with NaOH followed by treatment with hydrochloric acid.\(^{22}\)

\[\begin{align*}
\text{O-CH}_2\text{CONH} - \text{CH}_2\text{CNHN=CHAr} & \xrightarrow{\text{NaOH, HCl}} \text{O-CH}_2\text{CONHN=CHAr} \\
\text{148} & \rightarrow \text{149}
\end{align*}\]

Shah et al.\(^{23}\) synthesized the 4-thiazolidinones (151a-c) from hydrazone (150a-c) by refluxing with thioglycolic acid in dry benzene.

\[\begin{align*}
\text{O} & \xrightarrow{\text{CH}_2\text{CNHN=CHAr HSCH}_2\text{COOH}} \text{O} \\
\text{150a-c} & \rightarrow \text{151a-c}
\end{align*}\]

<table>
<thead>
<tr>
<th>Compound</th>
<th>Ar</th>
</tr>
</thead>
<tbody>
<tr>
<td>150a, 151a</td>
<td>C(_6)H(_5)</td>
</tr>
<tr>
<td>150b, 151b</td>
<td>2-OHC(_6)H(_4)</td>
</tr>
<tr>
<td>150c, 151c</td>
<td>4-Cl-C(_6)H(_4)</td>
</tr>
<tr>
<td>150d, 151d</td>
<td>4-CH(_3)OC(_6)H(_4)</td>
</tr>
</tbody>
</table>

Synthesis of 3-(4'-methyl-2'-quinolinyl)oxyacetamido-2-(substituted phenyl)-4-thiazolidinone (153a,b) from substituted-2-(4-methyl-2-quinolinyl)oxyacetylhydrazone (152a,b) was reported by Kidwai et al.\(^{24}\) by the microwave reaction.
Ling *et al.* synthesized 2-imino-3-(4-arylthiazol-2-yl)-thiazolidin-4-ones (155a,b) from 2-chloroacetamido-4-arylthiazoles (154a,b) by reacting with potassium thiocyanate in refluxing acetone.

Feray *et al.* synthesized 4-thiazolidinones (157a-d), which are substituted at the 2-position by the reaction of mercaptoacids with aldines (156a-d).
1,2,4-Triazoles and 4-Oxo-1,3-thiazolidines

<table>
<thead>
<tr>
<th>Compound</th>
<th>R</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>156a, 157a</td>
<td>H</td>
<td>H</td>
</tr>
<tr>
<td>156b, 157b</td>
<td>CH₃</td>
<td>H</td>
</tr>
<tr>
<td>156c, 157c</td>
<td>H</td>
<td>C₆H₅</td>
</tr>
<tr>
<td>156d, 157d</td>
<td>CH₃</td>
<td>C₆H₅</td>
</tr>
</tbody>
</table>

4-Acetylthiosemicarbazone-4'-acetyldiphenyl sulphide (158) on reaction with ethylchloroacetate in the presence of fused AcONa gave 4-(4"-thiazolidinone-2"-acetylazino)-4'-acetyldiphenyl sulphide (159).

Russowsky and Neto reported that the coupling reaction between piperidine-2-thione (160) and 2-bromo-2-phenylmethylacetate (161) afforded the β-enaminocarbonyl compound (162) and in most of the cases bicyclic thiazolidinone (163) was produced.

2,3-Diaryl-1,3-thiazolidin-4-ones (166a,b) was synthesized by reacting an aromatic aldehyde (165) with an equimolar amount of (hetero) aromatic amine (164) in the presence of an excess of thioglycolic acid.
1,2,4-Triazoles and 4-Oxo-1,3-thiazolidines

![Chemical Structures]

**Compound** | **X** | **Y** | **R^1** | **R^2** | **R^3** | **R^4**
--- | --- | --- | --- | --- | --- | ---
**166a** | CH | CH | CH₃ | H | Cl | H
**166b** | N | N | OCH₃ | H | F | Cl

Srivastava *et al.*³⁰ reported the one-pot procedure for the synthesis of 1-thia-4-aza *spiro*[4,5]-decan-3-one (168a-d), by the reaction of cyclohexanone (167) with substituted amine, substituted thioglycolic acid and dicyclohexylcarbodiimide (DCC) in dry THF at room temperature.

![Chemical Structures]

**Compound** | **R^1** | **R^2**
--- | --- | ---
**168a** | PhCH₂ | H
**168b** | C₅H₁₇ | H
**168c** | PhCH₂ | CH₃
**168d** | C₅H₁₇ | CH₃

Synthesis of 2-(1,2,4-benzotriazole)acetohydrazido-1,3-thiazolidin-4-one (170) from 2-(1,2,4-benzotriazole-1-yl-acetate)-hydrazine carbothioamide (169) and
chloroacetic acid in presence of sodium acetate in ethanol was reported by Ojha et al.\textsuperscript{31}

Gadre \textit{et al.}\textsuperscript{32} synthesized 6-N-2-(aryl)-thiazolin-4-one-3-yl-carboxyamido-2,5-bis-(4-methoxyphenyl)-3H-pyridizine-3-ones (172a-c) and 6-N-2-(aryl)-5-methyl-thiazolin-4-one-3-yl-carboxyamido-2,5-bis-(4-methoxyphenyl)-3H-pyridizine-3-ones (173a-c) from 6-N-2-(arylidene)-hydrazinocarbonyl-2,5-bis-(4-methoxyphenyl)-3H-pyridizine-3-ones (171) on reacting with thioglycolic acid and thiolactic acid respectively.
Recently Tomascikova et al. synthesized 4-(acridin-9-yl)-5-methyl/phenyl-2,4-dihydro[1,2,4]triazole-3-thione (175a,b) and Methyl[2-(acridin-9-ylimino)-3-(acetyl/benzoyl amino)-4-oxothiazolidin-5-ylidin]acetate (176a,b) from 4-(acridin-9-yl)-1-(acetyl/benzoyl)-thiosemicarbazide (174a,b).

Keeping in mind the practical utility of 1,2,4-triazoles and 4-oxo-1,3-thiazolidines an attempt was made to synthesize fatty acid derivatives containing these heterocyclic rings.
4.2 RESULTS AND DISCUSSION

Fatty acid hydrazides XIII-XVI, which are the required starting materials, were prepared from fatty alkenoates following the literature method reported previously. Reacting fatty acid hydrazides with phenyl isothiocyanate in dry benzene for 5 hrs under reflux and removing excess solvent under reduced pressure gave thiosemicarbazide XXXIII-XXXVI. Although the compounds XXXIII and XXXIV are reported in literature but they have been not characterized fully. Thiosemicarbazide XXXIII-XXXVI were subjected to intramolecular cyclization in alkaline medium (2M, NaOH) followed by acidification with HCl to give 1,2,4-triazoles XXXVII-XL. Since 1,2,4-triazole-3-thione may exist in thiol-thione tautomeric forms our investigations showed that in this case thione structure dominates. Structure of triazole XXXVII and XXXVIII appeared in literature without spectral data.

Cyclization of thiosemicarbazide XXXIII-XXXVI with chloroacetylchloride in chloroform gave 4-oxo-1,3-thiazolidine XLI-XLIV. Earlier works show that oxothiazolidines were prepared from different substituted thiosemicarbazides (other than fatty thiosemicarbazides) by reacting them with chloroacetic acid and anhydrous sodium acetate under drastic conditions like high temperature, more reaction time and use of high boiling point solvents e.g. acetic acid. In present study chloroacetylchloride was used to overcome all these lachrymatory conditions.

Reaction of undec-10-enoic hydrazide (XIII) with phenyl isothiocyanate

Fatty acid hydrazide XIII and phenyl isothiocyanate were refluxed in dry benzene for 5 hrs. The resulting solution was then concentrated by removing the excess solvent under reduced pressure (Scheme 4.1). The solid thus separated was filtered, dried and recrystallized in mixture of benzene-chloroform to get a white powder.
Scheme 4.1: Synthesis of 4-phenyl-1-(undec-10-enoyl)-thiosemicarbazide (XXXIII).

Structural elucidation of the compound XXXIII as 4-phenyl-1-(undec-10-enoyl)-thiosemicarbazide

Compound XXXIII showed IR bands at 3226 (NH), 1667 (C=O) and 1238 cm\(^{-1}\) (C=S). \(^1\)H NMR was more informative, characteristic peaks were observed at \(\delta\) 8.92 (2H, br. s, CO-\(\text{NHNH-}\)CS), 8.42 (1H, s, CS-NH-Ar) and 7.37-7.07 (5H, m, Ar-H). In \(^{13}\)C NMR peaks at \(\delta\) 165.4 (C=O), 160.8 (C=S) were observed. Detailed \(^1\)H NMR and \(^{13}\)C NMR spectral data are given in experimental section. Based on the above facts compound XXXIII was characterized as 4-phenyl-1-(undec-10-enoyl)-thiosemicarbazide.

Reaction of (9\(^Z\))-octadec-9-enoic hydrazide (XIV) with phenyl isothiocynate

Fatty acid hydrazide XIV and phenyl isothiocynate were refluxed for 5 hrs in dry benzene. The reaction mixture was concentrated by removing the excess solvent (Scheme 4.2). The solid mass thus separated was filtered, dried and recrystallized in mixture of benzene-chloroform to obtain white crystals.
Scheme 4.2: Synthesis of (9Z)-4-phenyl-1-(octadec-9-enoyl)-thiosemicarbazide (XXXIV).

**Structural elucidation of the compound XXXIV as (9Z)-4-phenyl-1-(octadec-9-enoyl)-thiosemicarbazide**

Characteristic IR bands at 3213 (NH), 1661 (C=O) and 1242 cm⁻¹ (C=S). In ¹H NMR characteristic peaks were observed at δ 8.65 (2H, br. s, CO-NHNH-CS), 8.40 (1H, s, CS-NH-Ar) and 7.34-7.17 (5H, m, Ar-H). In ¹³C NMR peaks at δ 165.4 (C=O), 160.8 (C=S) were observed. Elemental analysis established its molecular formula as C₂₅H₄₁N₃OS. Based on the above facts compound XXXIV was characterized as (9Z)-4-phenyl-1-(octadec-9-enoyl)-thiosemicarbazide.

**Reaction of (9Z,12R)-12-hydroxyoctadec-9-enoic hydrazide (XV) with phenyl isothiocyanate**

A mixture of fatty acid hydrazide XV and phenyl isothiocyanate were refluxed in dry benzene for 5 hrs. The resulting solution was concentrated by removing the excess solvent under reduced pressure (Scheme 4.3). The solid thus separated was filtered, dried and recrystallized in mixture of benzene-chloroform to get a white powder.
Scheme 4.3: Synthesis of (9Z,12R)-4-phenyl-1-(12-hydroxyoctadec-9-enoyl)-thiosemicarbazide (XXXV).

Structural elucidation of the compound XXXV as (9Z,12R)-4-phenyl-1-(12-hydroxyoctadec-9-enoyl)-thiosemicarbazide

Compound XXXV showed IR bands at 3293 (OH), 3222 (NH), 1661 (C=O) and 1236 cm$^{-1}$ (C=S). $^1$H NMR was more informative, characteristic peaks were observed at $\delta$ 8.94 (2H, br. s, CO-NH-NH-C=CS), 8.65 (1H, s, CS-NH-Ar) and 7.55-7.29 (5H, m, Ar-H). In $^{13}$C NMR peaks at $\delta$ 163.2 (C=O), 159.9 (C=S) were observed. Elemental analysis established its molecular formula as C$_{25}$H$_{41}$N$_3$O$_2$S. Based on the above facts compound XXXV was characterized as (9Z,12R)-4-phenyl-1-(12-hydroxyoctadec-9-enoyl)-thiosemicarbazide.

Reaction Reaction of (9Z,12Z)-9-hydroxyoctadec-12-enoic hydrazide (XVI) with phenyl isothiocyanate

Fatty acid hydrazide XVI and phenyl isothiocyanate (0.02 mol) were refluxed for 5 hrs in dry benzene. The reaction mixture was concentrated by removing the excess solvent (Scheme 4.4). The solid mass thus separated was filtered, dried and recrystallized in mixture of benzene-chloroform to obtain a white powder.
Scheme 4.4: Synthesis of (9R,12Z)-4-phenyl-1-(12-hydroxyoctadec-9-enoyl)-thiosemicarbazide (XXXVI).

Structural elucidation of the compound XXXVI as (9R,12Z)-4-phenyl-1-(9-hydroxyoctadec-12-enoyl)-thiosemicarbazide

Compound XXXVI showed IR bands at 3287 (OH), 3180 (NH), 1668 (C=O) and 1228 cm⁻¹ (C=S). $^1$H NMR was more informative, characteristic peaks were observed at δ 8.76 (2H, br. s, CO-NH-NH-CS), 8.12 (1H, s, CS-NHN-Ar) and 7.56-7.32 (5H, m, Ar-H). In $^{13}$C NMR peaks at δ 163.2 (C=O), 159.0 (C=S) were observed. Elemental analysis established its molecular formula as C$_{25}$H$_{41}$N$_3$O$_2$S. Based on the above facts compound XXXVI was characterized as (9R,12Z)-4-phenyl-1-(9-hydroxyoctadec-12-enoyl)-thiosemicarbazide.

Intramolecular cyclization of 4-phenyl-1-(undec-10-enoyl)-thiosemicarbazide (XXXIII)

Thiosemicarbazide XXXIII was subjected to intramolecular cyclization in alkaline medium (2M, NaOH) under reflux for 6 hrs (Scheme 4.5). The reaction mixture was cooled and acidified with HCl to give a crude product which was crystallized in mixture of chloroform and petroleum ether to give a white powder.
Scheme 4.5: Synthesis of 5-(dec-9-enyl)-4-phenyl-3-thion-2H-1,2,4-triazole (XXXVII).

Structural elucidation of the compound XXXVII as 5-(dec-9-enyl)-4-phenyl-3-thion-2H-1,2,4-triazole

Compound XXXVII gave diagnostic IR bands at 3181 (NH), 1541 (C=N) and 1243 cm⁻¹ (C=S) and no peak was observed around 2600-2550 cm⁻¹ indicating the absence of thiol form. The ¹H NMR was more informative in assigning the structure. In addition to peaks of fatty acid chain other characteristic peaks were observed at δ 11.39 (1H, s, NH), 7.55-7.31 (5H, m, Ar-H). In ¹³C NMR peaks at δ 168.2 (C=S), 153.0 (C=N) were observed. Elemental analysis and mass spectral data established its molecular formula C₁₉H₂₅N₃S. Based on the above facts compound XXXVI was characterized as 5-(dec-9-enyl)-4-phenyl-3-thion-2H-1,2,4-triazole.

Intermolecular cyclization of (9Z)-4-phenyl-1-(octadec-9-enoyl)-thiosemicarbazide (XXXIV)

Thiosemicarbazide XXXIV was subjected to intermolecular cyclization in alkaline medium (2M, NaOH) under reflux for 6 hrs (Scheme 4.6). After cooling the reaction mixture it was acidified with HCl to give a crude product which was recrystallized in mixture of chloroform and petroleum-ether to give white crystals.
Scheme 4.6: Synthesis of (8Z)-5-(heptadec-8-enyl)-4-phenyl-3-thion-1,2,4-2H-triazole (XXXVIII).

**Structural elucidation of the compound XXXVIII as (8Z)-5-(heptadec-8-enyl)-4-phenyl-3-thion-2H-1,2,4-triazole**

IR spectrum gave peaks at 3181 (NH), 1540 (C=N) and 1247 cm⁻¹ (C=S). In ¹H NMR peaks at δ 11.39 (1H, s, NH) and 7.59-7.31 (5H, m, Ar-H) and in ¹³C NMR peaks at 167.1 (C=S) and 153.5 (C=N) were observed. Elemental analysis and mass spectral data established its molecular formula C₂₅H₃₉N₃S. Thus compound XXXVIII was characterized as (8Z)-5-(heptadec-8-enyl)-4-phenyl-3-thion-2H-1,2,4-triazole.

**Intramolecular cyclization of (9Z,12R)-4-phenyl-1-(12-hydroxyoctadec-9-enoyl)-thiosemicarbazide (XXXV)**

Thiosemicarbazide XXXV was subjected to intramolecular cyclization in alkaline medium (2M, NaOH) under reflux followed by acidification with HCl to give a crude product which was crystallized in mixture of chloroform and petroleum-ether to give semisolid compound (Scheme 4.7).
Scheme 4.7: Synthesis of (8Z,11R)-5-(11-hydroxyheptadec-8-enyl)-4-phenyl-3-thion-2H-1,2,4-triazole (XXXIX).

Structural elucidation of the compound XXXIX as (8Z,11R)-5-(11-hydroxyheptadec-8-enyl)-4-phenyl-3-thion-2H-1,2,4-triazole

Diagnostic IR bands at 3307 (OH), 3182 (NH), 1504 (C=N) and 1248 cm⁻¹ (C=S) were observed. In ¹H NMR diagnostic peaks at δ 11.39 (1H, s, NH), 7.55-7.29 (5H, m, Ar-H) and in ¹³C NMR peaks at δ 163.2 (C=S), 159.9 (C=N) were observed. Elemental analysis and mass spectral data established its molecular formula C₂₅H₃₉N₃OS. Thus compound XXXIX was characterized as (8Z,11R)-5-(11-hydroxyheptadec-8-enyl)-4-phenyl-3-thion-2H-1,2,4-triazole

Intramolecular cyclization of (9Z,12Z)-4-phenyl-1-(9-hydroxyoctadec-12-enoyl)-thiosemicarbazide (XXXVI)

Thiosemicarbazide XXXVI was subjected to intermolecular cyclization in alkaline medium (2M, NaOH) under reflux for 6 hrs followed by acidification with HCl to give a crude product which was crystallized in chloroform and petroleum-ether to give white powder (Scheme 4.8).
1,2,4-Triazoles and 4-Oxo-1,3-thiazolidines

Scheme 4.8: Synthesis of (8R,11Z)-5-(8-hydroxyheptadec-11-enyl)-4-phenyl-3-thion-2H-1,2,4-triazole (XL).

Structural elucidation of the compound XL as (8R,11Z)-5-(8-hydroxyheptadec-11-enyl)-4-phenyl-3-thion-2H-1,2,4-triazole

Compound XL gave diagnostic IR bands at 3297 (OH), 3182 (NH), 1504 (C=N) and 1247 cm⁻¹ (C=S). In ¹H NMR peaks at δ 10.96 (1H, s, NH) and 7.43-7.30 (5H, m, Ar-H) were observed. In ¹³C NMR peaks at δ 167.7 (C=S) and 159.9 (C=N) were observed. Elemental analysis and mass spectral data established its molecular formula C₂₅H₃₉N₃OS. Based on the above facts compound XL was characterized as (8R,11Z)-5-(8-hydroxyheptadec-11-enyl)-4-phenyl-3-thion-2H-1,2,4-triazole.

Reaction of 4-phenyl-1-(undec-10-enoyl)-thiosemicarbazide (XXXIII) with chloroacetyl chloride

A mixture of thiosemicarbazide XXXIII and chloroacetyl chloride were refluxed in chloroform for 6 hrs. Excess solvent was distilled off under reduced pressure and the solid obtained was filtered and recrystallized in mixture of dimethyl formamide (DMF)-water to obtain a white powder.
Scheme 4.9: Synthesis of N-[4-oxo-2-(phenylimino)-1,3-thiazolidin-3-yl]undec-10-enamide (XLI).

Structural elucidation of the compound XLI as N-[4-oxo-2-(phenylimino)-1,3-thiazolidin-3-yl]undec-10-enamide

The IR spectrum of compound XLI showed absorption bands at 3226 (NH), 1660 (C=O), 1496 (C=N) and 666 cm\(^{-1}\) (C-S-C). The \(^1\)H NMR characteristic peaks were observed at \(\delta\) 8.65 (1H, s, NH), 7.39-7.07 (5H, m, Ar-H) and 2.93 (2H, s, CH\(_2\) ring). In \(^{13}\)C NMR peaks at \(\delta\) 174.3 (C=O, ring), 164.1 (C=O) and 153.4 (C=N) were observed. Elemental analysis and mass spectral data established its molecular formula C\(_{20}\)H\(_{27}\)N\(_3\)O\(_2\)S. Based on the above facts compound XLI was characterized as N-[4-oxo-2-(phenylimino)-1,3-thiazolidin-3-yl]undec-10-enamide.

Reaction of (9Z)-4-phenyl-1-(octadec-9-enoyl)-thiosemicarbazide (XXXIV) with chloroacetyl chloride

A mixture of thiosemicarbazide XXXIV and chloroacetyl chloride were refluxed in chloroform for 6 hrs. Excess solvent was removed under reduced pressure and the solid obtained was filtered and recrystallized in mixture of DMF-water to obtain a dirty white powder.
Scheme 4.10: Synthesis of (9Z)-N-[4-oxo-2-(phenylimino)-1,3-thiazolidin-3-yl]-octadec-9-enamide (XLII).

Structural elucidation of the compound XLII as (9Z)-N-[4-oxo-2-(phenylimino)-1,3-thiazolidin-3-yl]-octadec-9-enamide

The IR spectrum of compound XLII showed absorption bands at 3222 (NH), 1666 (C=O) 1491 (C=N) and 668 cm⁻¹ (C-S-C). The ¹H NMR characteristic peaks were observed at δ 8.65 (1H, s, NH), 7.59-7.28 (5H, m, Ar-H) and 2.91 (2H, s, CH₂ ring). In ¹³C NMR peaks at δ 174.4 (C=O, ring), 167.5 (C=O) and 164.0 (C=N) were observed. Elemental analysis and mass spectral data established its molecular formula C₂₇H₄₁N₃O₂S. Based on the above facts compound XLII was characterized as (9Z)-N-[4-oxo-2-(phenylimino)-1,3-thiazolidin-3-yl]-octadec-9-enamide.

Reaction of (9Z,12R)-4-phenyl-1-(12-hydroxyoctadec-9-enoxy)-thiosemicarbazide (XXXV) with chloroacetyl chloride

Thiosemicarbazide XXXV and chloroacetyl chloride were refluxed in chloroform for 6 hrs. Excess solvent was removed under reduced pressure and the solid obtained was filtered and recrystallized in mixture of DMF-water to obtain a white powder.
Scheme 4.11: Synthesis of (9Z,12R)-N-[4-oxo-2-(phenylimino)-1,3-thiazolidin-3-yl]-12-hydroxyoctadec-9-enamide (XLIII).

**Structural elucidation of the compound XLIII as (9Z,12R)-N-[4-oxo-2-(phenylimino)-1,3-thiazolidin-3-yl]-12-hydroxyoctadec-9-enamide**

Compound XLIII showed IR absorption bands at 3308 (OH), 3226 (NH), 1666 (C=O), 1491 (C=N) and 667 cm⁻¹ (C-S-C). The ¹H NMR peaks at δ 8.40 (1H, s, NH), 7.55-7.31 (5H, m, Ar-H) and 2.96 (2H, s, CH₂ ring) and in ¹³C NMR peaks at δ 174.9 (C=O, ring), 167.5 (C=O) and 164.0 (C=N) were observed. Elemental analysis and mass spectral data established its molecular formula C₂₇H₄₁N₃O₃S. Based on the above facts compound XLIII was characterized as (9Z,12R)-N-[4-oxo-2-(phenylimino)-1,3-thiazolidin-3-yl]-12-hydroxyoctadec-9-enamide.

**Reaction of (9R,12Z)-4-phenyl-1-(9-hydroxyoctadec-12-enoyl)-thiosemicarbazide (XXXVI) with chloroacetyl chloride**

Thiosemicarbazide XXXVI and chloroacetyl chloride were refluxed in chloroform for 6 hrs. Excess solvent was removed under reduced pressure and the solid obtained was filtered and recrystallized in mixture of DMF-water to obtain a white powder.
Structural elucidation of the compound XLIV as (9R,12Z)-N-[4-oxo-2-(phenylimino)-1,3-thiazolidin-3-yl]-9-hydroxyoctadec-12-enamide (XLIV).

IR absorption bands at 3287 (OH), 3228 (NH), 1666 (C=O), 1491 (C=N) and 667 cm\(^{-1}\) (C-S-C). The \(^1\)H NMR characteristic peaks at \(\delta\) 8.80 (1H, s, NH), 7.46-7.30 (5H, m, Ar-H) and 2.96 (2H, s, CH\(_2\) ring) were observed. In \(^1\)C NMR peaks at \(\delta\) 174.6 (C=O, ring), 167.3 (C=O) and 164.7 (C=N) were observed. Elemental analysis and mass spectral data established its molecular formula C\(_{27}\)H\(_{41}\)N\(_3\)O\(_3\)S.

Based on the above facts compound XLIV was characterized as (9R,12Z)-N-[4-oxo-2-(phenylimino)-1,3-thiazolidin-3-yl]-9-hydroxyoctadec-12-enamide.
1,2,4-Triazoles and 4-Oxo-1,3-thiazolidines

4.3 EXPERIMENTAL

Phenyl isothiocyanate was purchased from Merck, Mumbai, India. Chloroacetylichloride and hydrazine hydrate (80%) were purchased from S d FINE-CHEM Ltd (Mumbai, India). Thin layer chromatography was done on glass plates (20×5 cm) with a layer of silica gel G (Merck, Mumbai, India, 0.5 mm thickness). Mixture of petroleum ether-ethyl acetate-acetic acid (80:20:1, v/v) were used as developing solvents. Column chromatography was carried out on silica gel (Merck, Mumbai, India, 60-120 mesh). Rest of the chemicals and instruments used are reported in chapter I (page No 24).

General procedure for synthesis of 4-phenyl-1-(alkenoyl)-thiosemicarbazide

XXXIII-XXXVI

Fatty acid hydrazide XIII (0.02 mol) and phenyl isothiocyanate (0.02 mol) were refluxed in dry benzene (30 mL) for 5 hrs. The resulting solution was then concentrated by removing the excess solvent by distillation under reduced pressure. The solid thus separated was filtered, dried and recrystallized in mixture of benzene-chloroform to get XXXIII. Similarly compounds XXXIV, XXXV and XXXVI were synthesized from fatty acid hydrazides XIV, XV and XVI respectively.

4-Phenyl-1-(undec-10-enoyl)-thiosemicarbazide (XXXIII)

White powder, yield 78%, m.p. 105-107°C

IR (KBr, cm⁻¹) 3226 (NH), 1667 (C=O), 1238 (C=S)

¹H NMR (CDCl₃) δ 8.92 (2H, br s, CO-NH-NH-CS), 8.42 (1H, s, CS-NH-Ar), 7.37-7.07 (5H, m, Ar-H), 5.81 (tdd, 1H, J¹H-C₅H₅ = 6.6 Hz, J²H-C₅H₅ = 10.2 Hz, J³H-C₅H₅ = 17.2 Hz, CH₂=CH-), 5.01 (1H, dd, J¹H-C₅H₅ = 10.2 Hz, J²H-C₅H₅ = 2.1 Hz, H₁C=CH), 4.92 (1H, dd, J¹H-C₅H₅ = 17.2 Hz, J²H-C₅H₅ = 2.1 Hz, H₂C=C=CH₁), 2.35 (2H, t, J = 7.5 Hz, CH₂-CO), 2.02 (2H, m, CH₂=CH-CH₂), 1.72 (2H, m, CH₂=CH₂-CO), 1.26 (10H, br s, (CH₂)₅)

¹³C NMR (CDCl₃) δ 165.4, 160.8, 139.2, 133.2, 131.3, 128.9, 128.6, 114.2, 33.8, 29.9, 29.6, 29.3, 29.2, 29.1, 29.0, 28.9

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1,2,4-Triazoles and 4-Oxo-1,3-thiazolidines

Anal | Calcd for C_{18}H_{27}N_{3}OS: C 64.87, H 8.10, N 12.60, S 9.62.
     | Found: C 64.79, H 8.04, N 12.63, S 9.56 %.

(9Z)-4-Phenyl-1-(octadec-9-enoyl)-thiosemicarbazide (XXXIV). White crystals, yield 85%, m.p. 114-117 °C.

IR (KBr, cm\(^{-1}\)) | 3213 (NH), 1661 (C=O), 1242 (C=S).
\(^1\)H NMR (CDCl\(_3\)) | \(\delta\) 8.65 (2H, br. s, CO-NH-NH-CS), 8.40 (1H, s, CS-NH-Ar), 7.34-7.17 (5H, m, Ar-H), 5.31 (2H, m, CH\(_2\)-\(\mathrm{CH}=\mathrm{CH}-\mathrm{CH}_2\)), 2.32 (2H, \(J = 7.5\) Hz, CH\(_2\)-CO), 2.01 (4H, m, CH\(_2\)-CH=CH-CH\(_2\)), 1.68 (2H, m, CH\(_2\)-CH\(_2\)-CO), 1.26 (20H, br. s, (CH\(_2\))\(_{10}\)), 0.88 (3H, dist. t, terminus CH\(_3\)).

\(^{13}\)C NMR (CDCl\(_3\)) | \(\delta\) 165.4, 160.8, 139.2, 137.3, 133.2, 131.3, 128.8, 128.6, 31.9, 29.9, 29.8, 29.7, 29.5, 29.4 “three signals are hidden”, 29.3 “two signals are hidden”, 29.1, 22.7, 14.2.

Anal | Calcd for C\(_{25}\)H\(_{41}\)N\(_3\)OS: C 69.61, H 9.50, N 9.37, S 7.43.
     | Found: C 69.56, H 9.41, N 9.77, S 7.37 %.

(9Z,12\(R\))-4-Phenyl-1-(12-hydroxyoctadec-9-enoyl)-thiosemicarbazide (XXXV). White powder, yield 73%, m.p. 151-152 °C.

IR (KBr, cm\(^{-1}\)) | 3293 (OH), 3222 (NH), 1661 (C=O), 1236 (C=S).
\(^1\)H NMR (CDCl\(_3\)) | \(\delta\) 8.94 (2H, br. s, CO-NH-NH-CS), 8.65 (1H, s, CS-NH-Ar), 7.55-7.29 (5H, m, Ar-H), 5.51-5.43 (2H, m, CH\(_2\)-\(\mathrm{CH}=\mathrm{CH}-\mathrm{CH}_2\)), 3.59 (1H, m, CH-\(\mathrm{OH}\)), 2.31 (2H, \(J = 7.5\) Hz, CH\(_2\)-CO), 2.21 (1H, br. s, CH-\(\mathrm{OH}\)), 2.00 (4H, m, CH\(_2\)-CH=CH-CH\(_2\)), 1.72 (2H, m, CH\(_2\)-CH\(_2\)-CO), 1.25 (18H, br. s, (CH\(_2\))\(_9\)), 0.87 (3H, dist. t, terminus CH\(_3\)).

\(^{13}\)C NMR (CDCl\(_3\)) | \(\delta\) 163.2, 159.9, 138.7 “one signal hidden”, 132.2, 128.1, 128.0, 127.0, 70.7, 40.1, 39.9, 39.7, 39.5, 39.3, 31.3, 30.4, 29.1, 29.0, 28.8, 28.6, 25.1, 22.0, 13.6.

     | Found: C 67.04, H 9.04, N 9.43, S 7.06 %.
1,2,4-Triazoles and 4-Oxo-1,3-thiazolidines

(9R,12Z)-4-Phenyl-1-(9-hydroxyoctadec-12-enoyl)-thiosemicarbazide (XXXVI).
White powder, yield 75%, m.p. 152-153 °C.

IR (KBr, cm⁻¹) : 3287 (OH), 3180 (NH), 1668 (C=O), 1228 (C=S).

¹H NMR (CDCl₃) : δ 8.76 (2H, br. s, CO-NH/NH-CS), 8.12 (1H, s, CS-NH-Ar), 7.56-7.35 (5H, m, Ar-H), 5.37-5.14 (2H, m, CH₂-CH=CH-CH₂), 3.54 (1H, m, CH-OH), 2.38 (2H, t, J = 7.5 Hz, CH₂-CO), 2.11 (1H, br. s, CH-OH), 2.02 (4H, m, CH₂-CH=CH-CH₂), 1.67 (2H, m, CH₂-CH₂-CO), 1.26 (18H, br. s, (CH₂)₉), 0.86 (3H, dist. t, terminus CH₃).

¹³C NMR (CDCl₃) : δ 163.2, 159.0, 138.4, 137.6, 131.2, 128.7, 128.3, 125.5, 70.56, 40.1, 39.9, 36.3, 24.8, 31.3, 29.1, 29.0, 28.9, 28.8, 28.5, 28.4, 25.1, 22.3, 14.01.


General procedure for synthesis of 5-(alkenyl)-4-phenyl-3-thion-2H-1,2,4-triazole XXXVII-XL

Thiosemicarbazide XXXIII (0.01 mol) was dissolved in 30 mL of 2M NaOH solution and heated under reflux for 6 hrs. After cooling, the reaction mixture was acidified with HCl. Crude product was precipitated, filtered and washed with distilled water. The solid thus separated was dried and recrystallized in chloroform and petroleum ether to get a white powder XXXVII. Similarly compounds XXXVIII, XXXIX and XL were prepared from thiosemicarbazide XXXIV, XXXV and XXXVI respectively.

5-(dec-9-enyl)-4-phenyl-3-thion-2H-1,2,4-triazole (XXXVII). White powder, yield 76%, m.p. 85-87 °C.

IR (KBr, cm⁻¹) : 3181 (NH), 1541 (C=N), 1243 (C=S).

¹H NMR (CDCl₃) : δ 11.39 (1H, s, NH), 7.55-7.31 (5H, m, Ar-H), 5.81 (tdd, 1H, J₇₋₈,CH₂ = 6.8 Hz, J₈₋₉, =10.2 Hz, J₉₋₁₀, =17.8 Hz, CH₂=CH-), 5.00 (1H, dd, J₁₀₋₁₁, =10.2 Hz, J₁₁₋₁₂, = 2.2
1,2,4-Triazoles and 4-Oxo-1,3-thiazolidines

Hz, $H_2C=CH$), 4.92 (1H, dd, $J_{H_2CH}=17.8$ Hz, $J_{H_2CH}=2.2$ Hz, $H_2C=CH$), 2.43 (2H, t, $J = 7.5$ Hz, CH$_2$-α to ring), 2.03 (2H, m, CH$_2$=CH-CH$_2$), 1.64 (2H, m, CH$_2$-β to ring), 1.27 (10H, br s, (CH$_2$)$_3$)

$^{13}$C NMR (CDCl$_3$)

δ 168.2, 153.0, 139.1, 133.4, 130.0, 129.8, 127.9, 114.2, 33.7, 31.9, 29.1, 28.9 “one signal hidden”, 28.8, 28.7, 26.0

MS (FAB) m/z (%) 316 ([M+1]$^+$, 100), 274 (20), 261 (10), 246 (17), 232 (10), 218 (25), 204 (50), 191 (36), 176 (15)

Anal Calcd for C$_{18}$H$_{25}$N$_3$S C 68.56, H 7.92, N 13.33, S 10.16 Found C 68.43, H 7.83, N 13.41, S 10.02%

(8Z)-5-(heptadec-8-enyl)-4-phenyl-3-thio-2H-1,2,4-triazole (XXXVIII). White crystals, yield 85%, m.p 88-90 °C

IR (KBr, cm$^{-1}$) 3181 (NH), 1540 (C=N), 1247 (C=S)

$^1$H NMR (CDCl$_3$)

δ 11.39 (1H, s, NH), 7.59-7.31 (5H, m, Ar-H), 5.53 (2H, m, CH$_2$-CH=CH-CH$_2$), 2.46 (2H, t, $J = 7.5$ Hz, CH$_2$-α to ring), 2.04 (4H, m, CH$_2$-CH=CH-CH$_2$), 1.70 (2H, m, CH$_2$-β to ring), 1.25 (20H, br. s, (CH$_2$)$_{10}$), 0.87 (3H, dist t, terminus CH$_3$)

$^{13}$C NMR (CDCl$_3$)

δ 167.1, 153.5, 139.0 “one signal hidden”, 131.5, 129.0, 126.8, 124.1, 37.1, 31.9, 29.7 “two signals are hidden”, 29.6, 29.4 “three signals are hidden”, 29.2, 29.1, 26.6, 22.6, 14.0

MS (FAB) m/z (%) 414 ([M+1]$^+$, 100), 398 (15), 356 (10), 327 (15), 301 (15), 274 (20), 260 (24), 246 (15), 232 (15), 218 (20), 204 (45), 191 (55), 177 (10)

Anal Calcd for C$_{25}$H$_{39}$N$_3$S C 72.63, H 9.43, N 10.16, S 7.75 Found C 72.49, H 9.30, N 10.27, S 7.66%
1,2,4-Triazoles and 4-Oxy-1,3-thiazolidines

(8Z,11R)-5-(11-hydroxyheptadec-8-enyl)-4-phenyl-3-thion-2H-1,2,4-triazole (XXXIX). Semisolid, yield 67%.

IR (KBr, cm⁻¹) : 3307 (OH), 3182 (NH), 1504 (C=N), 1248 (C=S).

¹H NMR (CDCl₃) : δ 11.39 (1H, s, NH), 7.55-7.29 (5H, m, Ar-H), 5.51 (2H, m, CH₂-CH=CH-CH₂), 3.59 (1H, m, CH-OH), 2.46 (2H, t, J = 7.5 Hz, CH₂- α to ring), 2.17 (1H, br. s, CH-OH), 2.11 (4H, m, CH₂-CH=CH-CH₂), 1.72 (2H, m, CH₂- β to ring), 1.25 (18H, br. s, (CH₂)₉), 0.87 (3H, dist. t, terminus CH₃).

¹³C NMR (CDCl₃) : δ 163.2, 159.9, 139.8, 139.0, 131.2, 129.0, 126.8, 125.5, 70.5, 39.9, 39.7, 31.3, 29.4, 29.1, 29.0, 28.8, 28.5, 28.4, 28.3, 26.7, 25.8, 22.0, 13.6.

MS (FAB) m/z (%) : 430 ([M+1]+, 55), 412 (100), 397 (10), 354 (15), 327 (15), 332 (10), 314 (15), 274 (25), 260 (30), 232 (17), 218 (15), 213 (14), 204 (30), 190 (50), 175 (13).

Anal : Calcd for C₂₅H₃₉N₃OS: C 69.93, H 9.08, N 9.78, S 7.46. Found: C 69.78, H 8.96, N 9.88, S 7.35%.

(8R,11Z)-5-(8-hydroxyheptadec-11-enyl)-4-phenyl-3-thion-2H-1,2,4-triazole (XL). White powder, yield 77%, m.p 198 °C.

IR (KBr, cm⁻¹) : 3297 (OH), 3182 (NH), 1504 (C=N), 1247 (C=S).

¹H NMR (CDCl₃) : δ 10.96 (1H, s, NH), 7.43-7.30 (5H, m, Ar-H), 5.38 (2H, m, CH₂-CH=CH-CH₂), 3.57 (1H, m, CH-OH), 2.45 (2H, t, J = 7.5 Hz, CH₂- α to ring), 2.15 (1H, br. s, CH-OH), 2.13 (4H, m, CH₂-CH=CH-CH₂), 1.68 (2H, m, CH₂- β to ring), 1.24 (18H, br. s, (CH₂)₉), 0.88 (3H, dist. t, terminus CH₃).

¹³C NMR (CDCl₃) : δ 167.7, 159.9, 139.1 “one signal hidden”, 130.0, 129.8, 127.9, 125.5, 70.4, 38.6, 34.1, 32.0, 29.7, 29.6, 29.5, 29.4 “one signal hidden”, 29.3, 29.2, 28.8, 25.0, 22.6, 14.0.

MS (FAB) m/z (%) : 430 ([M+1]+, 40), 412 (100), 383 (10), 356 (15), 342 (15), 327 (13), 313 (10), 302 (35), 274 (23), 260 (25), 246
1,2,4-Triazoles and 4-Oxo-1,3-thiazolidines

(18), 232 (18), 218 (15), 211(10), 204 (35), 191 (25), 176 (15), 155 (18), 111 (16), 97 (20)

Anal : Calcd for C_{25}H_{39}N_{3}OS: C 69.93, H 9.08, N 9.78, S 7.46.
Found: C 69.82, H 9.01, N 9.83, S 7.37%

General procedure for synthesis of N-[4-oxo-2-(phenylimino)-1,3-thiazolidin-3-yl]-alkenamide XLI-XLIV

A mixture of thiosemicarbazide XXXIII (0.01 mol) and chloroacetylchloride (0.01 mol) were refluxed in chloroform (50 mL) for 6 hrs. Excess solvent was removed by distillation under reduced pressure and the solid obtained was filtered and washed with ethanol and recrystallized in mixture of DMF-water to obtain compound XLI. Similarly compounds XLII, XLIII and XLIV were prepared from thiosemicarbazide XXXIV, XXXV and XXXVI respectively.

N-[4-oxo-2-(phenylimino)-1,3-thiazolidin-3-yl]-undec-10-enamide (XLI). White powder, yield 70%, m.p. 175-177 °C.

IR (KBr, cm⁻¹) : 3226 (NH), 1660 (C=O), 1496 (C=N), 666 (C-S-C).

\( ^{1}H \text{NMR (CDCl}_3\) : δ 8.65 (1H, s, NH), 7.39-7.07 (5H, m, Ar-H), 5.77 (tdd, 1H, \( J_{H_{-}CH_{2}} = 6.6 \text{ Hz}, J_{H_{-}H_{z}} =10.2 \text{ Hz}, J_{H_{-}H_{g}} =17.1 \text{ Hz},\)

\(CH_{2}=C\)) , 5.01 (1H, dd, \( J_{H_{z}-H} =10.2 \text{ Hz}, J_{H_{z}-H_{g}} =2.1 \text{ Hz} \), \(H_{z}C=CH\)), 4.92 (1H, dd, \( J_{H_{g}-H} =17.1 \text{ Hz}, J_{H_{g}-H_{z}} =2.1 \text{ Hz} \), \(H_{g}C=CH\)), 2.93 (2H, s, CH2 ring), 2.33 (2H, t, \( J = 7.5 \text{ Hz}, CH_{2}-CO\)), 2.04 (2H, m, \(CH_{2}=CH-CH_{2}\)), 1.64 (2H, m, \(CH_{2}CH_{2}-CO\)), 1.26 (10H, br. s, (CH2)s).

\( ^{13}C \text{NMR (CDCl}_3\) : δ 174.3, 164.1, 153.4, 139.0, 130.8, 129.0, 127.9, 125.6, 114.4, 37.1, 33.7, 28.9 “two signals signals hidden”, 28.7 “two signals signals hidden”, 25.8.

MS (FAB) m/z (%) : 374 ([M+1] \(^{\dagger}\), 15), 281 (17), 241 (100), 183 (15), 167 (26), 139 (32), 111 (8), 97 (12), 91 (20).

Anal: Calcd for C_{29}H_{27}N_{3}O_{2}S: C 64.35, H 7.23, N 11.25, S 8.58
Found: C 64.27, H 7.18, N 11.33, S 8.41%.
1,2,4-Triazoles and 4-Oxo-1,3-thiazolidines

(9Z)-N-[4-oxo-2-(phenylimino)-1,3-thiazolidin-3-yl]-octadec-9-enamide (XLII). Dirty white powder, yield 73%, m.p. 184-186 °C.

IR (KBr, cm⁻¹) : 3222 (NH), 1666 (C=O), 1491 (C=N), 668 (C-S-C).

¹H NMR (CDCl₃) : δ 8.65 (1H, s, NH), 7.59-7.28 (5H, m, Ar-H), 5.32 (2H, m, CH₂-CH=CH-CH₂), 2.91 (2H, s, CH₂ ring), 2.32 (2H, t, J = 7.5 Hz, CH₂-C=CH₂), 1.64 (2H, m, CH₂CH₂-CO), 1.26 (20H, br. s, (CH₂)₁₀), 0.88 (3H, dist. t, terminus CH₃).


MS (FAB) m/z (%) : 472 ([M+1] ‡, 10), 394 (18), 380 (15), 318 (17), 304 (15), 281 (20), 265 (17), 237 (27), 223 (17), 209 (15), 195 (25), 181 (15), 167 (20), 153 (32), 139 (32), 113 (12), 97 (100).

Anal : Calcd for C₂₇H₄₁N₃O₂S: C 68.79, H 8.69, N 8.91, S 6.80. Found: C 68.54, H 8.61, N 8.99, S 6.68%.

(9Z,12R)-N-[4-oxo-2-(phenylimino)-1,3-thiazolidin-3-yl]-12-hydroxyoctadec-9-enamide (XLIII). White powder, yield 68%, m.p. 155-157 °C.

IR (KBr, cm⁻¹) : 3308 (OH), 3226 (NH), 1666 (C=O), 1491 (C=N), 667 (C-S-C).

¹H NMR (CDCl₃) : δ 8.40 (1H, s, NH), 7.55-7.31 (5H, m, Ar-H), 5.55 (2H, m, CH₂-CH=CH-CH₂), 3.59 (1H, m, CH⁻OH), 2.96 (2H, s, CH₂ ring), 2.31 (2H, t, J = 7.5 Hz, CH₂-CO), 2.21 (1H, br. s, CH⁻OH), 2.00 (4H, m, CH₂⁻CH=CH-CH₂), 1.67 (2H, m, CH₂CH₂-CO), 1.26 (18H, br. s, (CH₂)₁₀), 0.88 (3H, dist. t, terminus CH₃).
**1,2,4-Triazoles and 4-Oxo-1,3-thiazolidines**

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<th>Compound</th>
<th>NMR/MS Analysis</th>
<th>Additional Information</th>
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<tr>
<td>13C NMR (CDCl₃)</td>
<td>δ 174.9, 167.5, 164.0, 131.2, 131.1, 129.8, 126.1, 125.5, 124.3, 72.0, 37.1, 33.7, 29.7, 29.6, 29.4, 29.2, 29.1, 28.9, “three signals signals hidden”, 28.7, 26.0, 22.4, 14.2</td>
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<tr>
<td>MS (FAB) m/z (%)</td>
<td>488 ([M⁺]+, 11), 470(13), 412 (14), 396 (10), 297 (100), 281 (20), 265 (35), 236 (8), 208 (12), 194 (15), 181 (15), 154 (12), 138 (12), 112 (28), 97 (40).</td>
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</table>

**(9R,12Z)-N-[4-oxo-2-(phenylamino)-1,3-thiazolidin-3-yl]-9-hydroxyoctadec-12-enamide (XLIV)**. White powder, yield 73%, m.p. 156-158 °C.

<table>
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<tr>
<th>IR (KBr, cm⁻¹)</th>
<th>3287 (OH), 3228 (NH), 1666 (C=O), 1491 (C=N), 667 (C-S-C).</th>
</tr>
</thead>
<tbody>
<tr>
<td>¹H NMR (CDCl₃)</td>
<td>δ 8.8 (1H, s, NH), 7.46-7.30 (5H, m, Ar-H), 5.37 (2H, m, CH₂-CH=CH-CH₂), 3.54 (1H, m, CH-OH), 2.96 (2H, s, CH₂ ring), 2.30 (2H, t, J = 7.5 Hz, CH₂-CO), 2.12 (1H, br. S, CH-OH), 2.02 (4H, m, CH₂-CH=CH-CH₂), 1.58 (2H, m, CH₂CH₂-CO), 1.26 (18H, br. s, (CH₃)₂), 0.88 (3H, dist. t, terminus CH₃).</td>
</tr>
<tr>
<td>¹³C NMR (CDCl₃)</td>
<td>δ 174.6, 167.3, 164.7, 139.4, 134.1, 129.8, 126.1, 125.5, 124.3, 72.0, 34.1, 31.7, 29.4, 29.2, 29.1, 28.9, 28.7, 28.4, “three signals signals hidden”, 28.3, 25.6, 22.0, 14.0.</td>
</tr>
<tr>
<td>MS (FAB) m/z (%)</td>
<td>488 ([M⁺]+, 14), 470(11), 396 (10), 297 (100), 281 (25), 263 (28), 222 (8), 207 (10), 152 (12), 138 (20), 111 (16), 97 (32), 82 (35).</td>
</tr>
</tbody>
</table>
1,2,4-Triazoles and 4-Oxo-1,3-thiazolidines

4.4 REFERENCES

1,2,4-Triazoles and 4-Ox-1,3-thiazolidines

34. A. Rauf, S. Sharma, S. Gangal, ARKIVOC, 2007, xvi, 137.