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# Synthesis and Biological Activity of 4-(4-Hydroxybenzylidene)-2-(substituted styryl) oxazol-5-ones and Their *o*-glucosides

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The 4-(4-hydroxybenzylidene)-2-methyl oxazol-5-ones **1** were treated with various aldehydes in the presence of acetic acid to form 4-(4-hydroxybenzylidene)-2-(substituted styryl) oxazol-5-ones **2a-i**, which were glucosylated using  $\alpha$ -acetobromoglucose as a glucosyl donor to afford 4-(4-*o*- $\beta$ -d-tetra-*o*-acetyl-glucoxybenzylidene)-2-(substituted styryl) oxazol-5-ones **3a-i**, which were deacetylated using zinc acetate in absolute methanol to form 4-(4-*o*- $\beta$ -d-glucoxybenzylidene)-2-(substituted styryl) oxazol-5-ones **4a-i**. The compounds showed good antimicrobial and antifungal activity.

**Key Words:** Oxazolone,  $\alpha$ -acetobromoglucose, decetylation, *o*-glucosides, antimicrobial and antifungal activity.

## Introduction

Heterocyclic compounds are widely distributed in nature and are essential for life. They play a vital role in the metabolism of all living cells. There are vast numbers of pharmacologically active heterocyclic compounds, many of which are in regular clinical use. Oxazoles play a vital role in the manufacture of various biologically active drugs as anti-inflammatory, antidepressant, fluorescent whitening agent, scintillator properties, analgesics, etc.<sup>1-8</sup> Glycoconjugates and carbohydrate containing structures have a variety of biological and therapeutic properties. Glycosides have a wide range of biological activities including antibacterial, antifungal, antiviral, anticancer, and antitumor activities.<sup>9-12</sup>

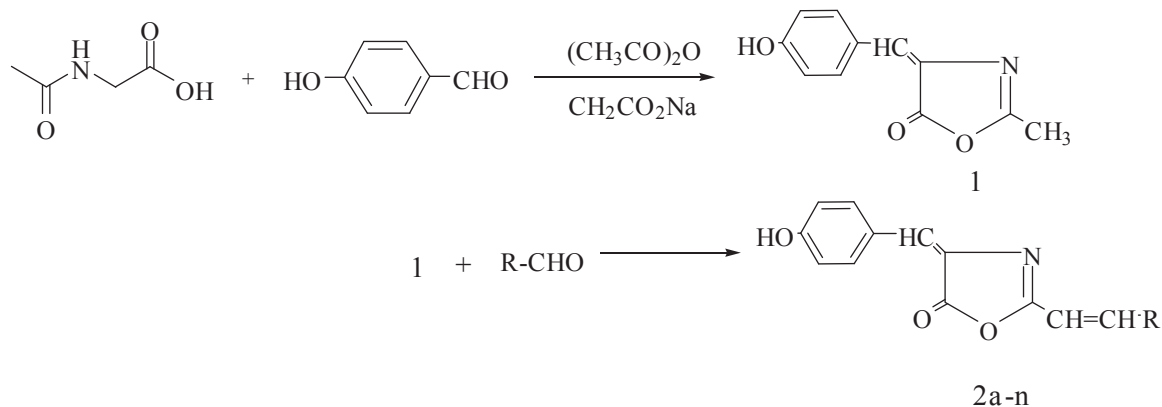
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\*Corresponding author

Thus, keeping in view the pharmacological activity of oxazole and the importance of glucoside in metabolism and in continuation of our work,<sup>13</sup> 4-(4-*o*- $\beta$ -d-glucosybenzylidene)-2-(substituted styryl) oxazol-5-ones were synthesized. Moreover, some of the compounds were evaluated for their biological activity.

## Results and Discussion

The starting compounds 4-(4-hydroxybenzylidene)-2-methyl oxazol-5-ones **1** were synthesized by known methods<sup>14</sup> from acetylglycine and *p*-hydroxy benzaldehyde. Thus compound **1** reacted with various aldehydes in the presence of acetic acid to form 4-(4-hydroxybenzylidene)-2-(substituted styryl) oxazol-5-ones **2a-i**. The IR spectrum of **2a** shows a broad peak at 3430 (-OH), due to the presence of phenolic -OH group, 1510 (C=N), 1554 (C=C), 1701 (C=O), 3010, 3085 (Ar-CH). <sup>1</sup>H-NMR  $\delta$  5.15 (s, 1H, Ar-OH, exchangeable with D<sub>2</sub>O),  $\delta$  5.20 (d, 1H, CH=CH-Ar),  $\delta$  6.80 (d, 1H, CH=CH-Ar),  $\delta$  7.20 the signal due to exocyclic vinylic proton.



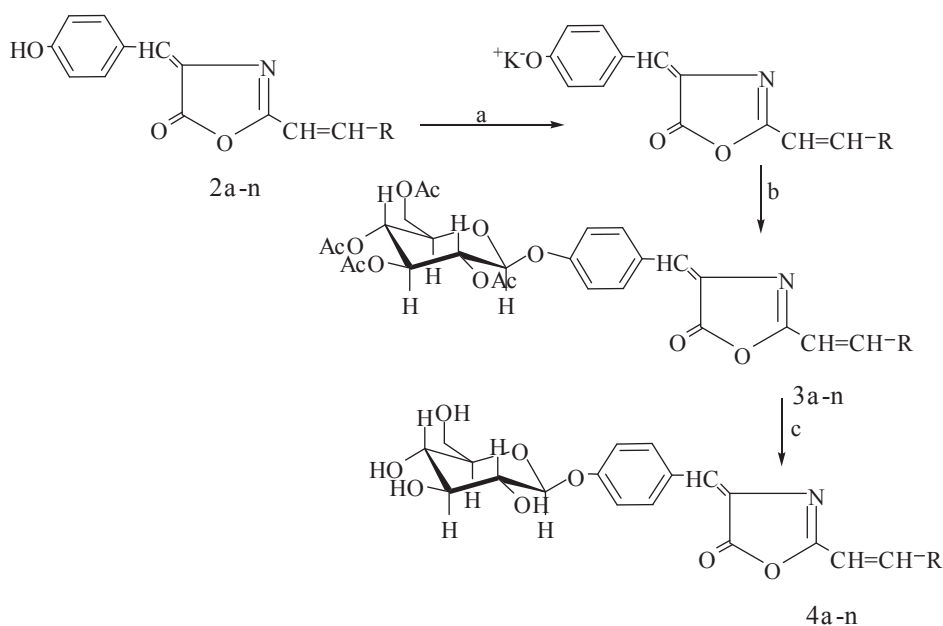
R =

- |  |  |  |   |
|--|--|--|---|
| a) C <sub>6</sub> H <sub>5</sub>                       | b) 2-Cl C <sub>6</sub> H <sub>4</sub>                  | c) 3-Cl C <sub>6</sub> H <sub>4</sub>                  | d) 4-Cl C <sub>6</sub> H <sub>4</sub>                               |
| e) 2-(OCH <sub>3</sub> ) C <sub>6</sub> H <sub>4</sub> | f) 3-(OCH <sub>3</sub> ) C <sub>6</sub> H <sub>4</sub> | g) 4-(OCH <sub>3</sub> ) C <sub>6</sub> H <sub>4</sub> | h) 3-NO <sub>2</sub> C <sub>6</sub> H <sub>4</sub>                  |
|  |  |  | i) 4-N(CH <sub>3</sub> ) <sub>2</sub> C <sub>6</sub> H <sub>5</sub> |

**Scheme 1.** Synthesis of 4-(4-hydroxybenzylidene)-2-(substituted styryl) oxazol-5-ones.

Glucosylation<sup>15</sup> of the product **2a-i** was carried out using  $\alpha$ -glucopyranosyl bromide, which was prepared from bromination of glucose pentacetate. The potassium salt of **2a-i** was prepared using argon atmosphere in dry acetonitrile in the presence of 18-crown-6 ether as a catalyst. The salt of aglycon and  $\alpha$ -glucopyranosyl bromide were used for the glucosylation to afford 4-(4-*o*- $\beta$ -d-tetra-*o*-acetyl-glucosybenzylidene)-2-(substituted styryl) oxazol-5-ones **3a-i**. The compound was obtained in good yield and its structure was confirmed by the IR spectrum (absence of phenolic -OH group at 3454 cm<sup>-1</sup> and the presence of C=N and C=O groups at 1610 cm<sup>-1</sup> and 1710 cm<sup>-1</sup>, respectively). The absorption peak at 1088 cm<sup>-1</sup> was attributed to C-O-C stretching. The  $\alpha$ -anomer of acetylated **3a** was confirmed by <sup>1</sup>H-NMR, and the anomeric proton 1-H resonated as a doublet at  $\delta$  5.10 with coupling constant J<sub>1-2</sub> = 3.2 Hz, establishing the  $\alpha$ -stereochemistry of the glucosidic bond. Further, 4-(4-*o*- $\beta$ -d-tetra-*o*-acetyl-glucosybenzylidene)-2-(substituted styryl) oxazol-5-ones undergo deacetylation<sup>16</sup> using

zinc acetate and absolute methanol (Scheme 2) to form 4-(4-*o*- $\beta$ -d-glucosybenzylidene)-2-(substituted styryl) oxazol-5-ones **4a-i**. IR spectra of **4a** showed a broad band at  $3405\text{ cm}^{-1}$  (intramolecular  $\text{-OH}$ , broad, stretch). This indicates the presence of a carbohydrate hydroxyl group. The  $\beta$ -d-glucopyranosyl ring band was observed at  $1028\text{ cm}^{-1}$ , which confirmed the formation of *o*-glucosides.  $^1\text{H-NMR}$  displays a signal due to sugar proton between  $\delta$  3.1 and 4.0 ppm. The  $\beta$ -anomeric configuration was established by the appearance of doublet  $\delta$  5.2 ppm, aromatic ring proton between 7.4 and 8.20 ppm, 5.6 (1H,  $\text{CH}=\text{CH-Ar}$ ), 6.6 ppm (1H,  $\text{CH}=\text{CH-Ar}$ ),  $\delta$  7.20 (s, 1H, exocyclic vinylic). In the EI-MS study of **4a**, the molecular ion peak at  $m/z$  453 (M) was dominated by 290 (100%), with the loss of 163 amu corresponding to the loss of sugar moiety. This fragmentation pattern is characteristic of *o*-glucosidically linked sugar. Also the molecular ion of  $m/z$  453 (M) confirmed the molecular formula of the corresponding glucoside **4a**. All the compounds **4a-i** gave satisfactory IR, NMR, optical rotation, and elemental analysis data correlation with the assigned structure.



R =

- |  |  |  |  |
|--|--|--|--|
| a) $\text{C}_6\text{H}_5$                      | b) 2-Cl $\text{C}_6\text{H}_4$                 | c) 3-Cl $\text{C}_6\text{H}_4$                 | d) 4-Cl $\text{C}_6\text{H}_4$   |
| e) 2-( $\text{OCH}_3$ ) $\text{C}_6\text{H}_4$ | f) 3-( $\text{OCH}_3$ ) $\text{C}_6\text{H}_4$ | g) 4-( $\text{OCH}_3$ ) $\text{C}_6\text{H}_4$ | h) 3- $\text{NO}_2$ $\text{C}_6\text{H}_4$ ,<br>i) 4-N $(\text{CH}_3)_2\text{C}_6\text{H}_5$ |

**Scheme 2.** 4-(4-*o*- $\beta$ -d-glucosybenzylidene)-2-(substituted styryl) oxazol-5-ones (a)  $\text{K}_2\text{CO}_3$ ,  $\text{CH}_3\text{CN}$ , argon atmosphere; (b)  $\alpha$ -glucopyranosyl bromide, 18-crown-6; (c)  $\text{Zn}(\text{OAc})_2$ ,  $\text{MeOH}$ .

## Biological Activity

### Antibacterial activity

The synthesized compounds were screened for their antibacterial activities against pathogenic bacteria such as *Escherichia coli*, *Staphylococcus aureus*, *Bacillus subtilis*, and *Klebsiella aerogenes* using the cup plate diffusion

method. The test compounds were dissolved in methanol at a concentration of 100  $\mu\text{g}/\text{mL}$  using Ciprofloxacin and Sulphacetamide as standard drugs.

## Antifungal activity

The synthesized compounds were also screened for their antifungal activity against *Aspergillus niger* and *Candida albicans* using the cup plate diffusion method by dissolving methanol at a concentration of 100  $\mu\text{g}/\text{mL}$ . The zone of inhibition was at after 7 days and 20 °C and it was compared with Gentamycin and Clotrimazole as standard drugs as shown in Table.

## Experimental

FT-IR spectra were recorded on a KBr disk on a Perkin-Elmer infrared spectrophotometer.  $^1\text{H}$ -NMR and  $^{13}\text{C}$ -NMR were obtained from a Bruker II-400 NMR spectrophotometer ( $^1\text{H}$ , 400 MHz and  $^{13}\text{C}$ , 100 MHz) using TMS as an internal standard in DMSO- $d_6$ . Mass spectra were recorded on a Hitachi Perkins-Elmer RMU 6D mass spectrophotometer. Purity of the compounds was checked on silica gel G plates using iodine vapor as visualizing agent. Elemental analyses were performed using the FLASH EA 1112 CHN analyzer, Thermo Finnigan, Italy. The 4-(4-hydroxybenzylidene)-2-methyl oxazol-5-ones **1** was prepared by a known procedure.

**General procedure for the preparation of 4-(4-hydroxybenzylidene)-2-(substituted styryl) oxazol-5-ones**<sup>17</sup> (**2a**). 4-(4-Hydroxybenzylidene)-2-methyl oxazol-5-ones **1** (0.01 mol) was refluxed with benzaldehyde (0.01 mol) in glacial acetic acid (10 mL) for 2 h on a sand bath. Completion of the reaction was tested by TLC. The reaction mixture was poured onto crushed ice; the residue was filtered, and washed with acetic acid. The crude product was crystallized from methanol to get 4-(4-hydroxybenzylidene)-2 styryl oxazol-5-ones **2a** yield 65%; mp 260 °C. FT-IR (KBr)  $\text{cm}^{-1}$ : 3430 (-OH), due to the presence of phenolic -OH group, 3010, 3085 (aromatic str.), 1701 (C=O), 1554 (C=C), 1510 (C=N);  $^1\text{H}$ -NMR (DMSO- $d_6$ ) $\delta$  ppm: 5.15 (s, 1H, Ar-OH, exchangeable with D<sub>2</sub>O), 5.20 (d, 1H, CH=CH-Ar), 6.80 (1H, CH=CH-Ar), 7.20 (s, 1H, exocyclic vinylic). Anal. Calcd for C<sub>18</sub>H<sub>13</sub>NO<sub>3</sub> (291) C, 74.22; H, 4.50; N, 4.81 found C, 74.26; H, 4.48; N, 4.82, R<sub>f</sub>=0.68. Similarly, all the compounds **2a-i** were synthesized using this method and spectral data of some compounds are given as follows.

**4-(4-hydroxybenzylidene)-2-(2-chloro styryl) oxazol-5-ones (2b)**. Yield 70%; mp 238 °C (methanol); FT-IR (KBr)  $\text{cm}^{-1}$ : 3450 (phenolic -OH), 2978, 3019 (aromatic str.), 1695 (C=O), 1532 (C=N) 1568 (C=C);  $^1\text{H}$ -NMR (DMSO- $d_6$ ) $\delta$  ppm: 5.05 (s, 1H, Ar-OH, exchangeable with D<sub>2</sub>O), 5.16 (d, 1H, CH=CH-Ar), 6.84 (d, 1H, CH=CH-Ar), 7.12 (s, 1H, exocyclic vinylic); R<sub>f</sub>=0.67. Anal. Calcd for C<sub>18</sub>H<sub>12</sub>ClNO<sub>3</sub> (325) C, 66.37; H, 3.71; N, 4.30 found C, 66.30; H, 3.68; N, 4.35.

**4-(4-hydroxybenzylidene)-2-(3-chloro styryl) oxazol-5-ones (2c)**. Yield 62%; mp 230 °C (methanol); FT-IR (KBr)  $\text{cm}^{-1}$ : 3350 (phenolic -OH), 1666 (C=O), 1512 (C=N), 1568 (C=C) and 2755, 2885 (aromatic str.);  $^1\text{H}$ -NMR (DMSO- $d_6$ ) $\delta$  ppm: 4.85 (s, 1H, Ar-OH, exchangeable with D<sub>2</sub>O), 5.12 (d, 1H, CH=CH-Ar), 6.80 (1H, CH=CH-Ar), 7.20 (s, 1H, exocyclic vinylic); R<sub>f</sub>=0.54. Anal. Calcd for C<sub>18</sub>H<sub>12</sub>ClNO<sub>3</sub> (325) C, 66.37; H, 3.71; N, 4.30 found C, 66.35; H, 3.69; N, 4.32.

**Table.** Biological activity 4-(4-*o*- $\beta$ -d-glucoxybenzylidene)-2-(substituted styryl) oxazol-5-ones. Zone of Inhibition<sup>b</sup> (mm) (Activity Index)<sup>std</sup>.

Zone of Inhibition <sup>b</sup> (mm) (Activity Index) <sup>std</sup>						
Entry	Antibacterial Activity				Antifungal Activity	
	Gram-positive		Gram-negative		<i>C. albicans</i>	<i>A. niger</i>
	<i>S. aureus</i>	<i>B. subtilis</i>	<i>E. coli</i>	<i>K. aerogenes</i>		
<b>4a</b>	29(0.85)* (0.93) <sup>#</sup>	28(0.96)* (1.07) <sup>#</sup>	24(0.68)* (0.82) <sup>#</sup>	18(0.81)* (0.85) <sup>#</sup>	16(0.76)* (0.69) <sup>#</sup>	24(0.96)* (1.00) <sup>#</sup>
<b>4b</b>	19(0.55)* (0.61) <sup>#</sup>	24(0.82)* (0.92) <sup>#</sup>	16(0.45)* (0.55) <sup>#</sup>	17(0.77)* (0.80) <sup>#</sup>	21(1.00)* (0.91) <sup>#</sup>	22(0.88)* (0.91) <sup>#</sup>
<b>4c</b>	23(0.67)* (0.74) <sup>#</sup>	15(0.51)* (0.57) <sup>#</sup>	23(0.65)* (0.79) <sup>#</sup>	19(0.86)* (0.90) <sup>#</sup>	22(1.04)* (0.95) <sup>#</sup>	21(0.84)* (0.87) <sup>#</sup>
<b>4d</b>	30(0.88)* (0.96) <sup>#</sup>	26(0.89)* (1.00) <sup>#</sup>	29(0.82)* (1.00) <sup>#</sup>	22(1.00)* (1.04) <sup>#</sup>	17(0.80)* (0.73) <sup>#</sup>	17(0.68)* (0.70) <sup>#</sup>
<b>4e</b>	12(0.35)* (0.38) <sup>#</sup>	15(0.51)* (0.57) <sup>#</sup>	18(0.51)* (0.62) <sup>#</sup>	20(0.90)* (1.95) <sup>#</sup>	11(0.52)* (0.47) <sup>#</sup>	21(0.84)* (0.87) <sup>#</sup>
<b>4f</b>	22(0.64)* (0.70) <sup>#</sup>	12(0.41)* (0.46) <sup>#</sup>	22(0.62)* (0.75) <sup>#</sup>	14(0.63)* (0.66) <sup>#</sup>	20(0.95)* (0.86) <sup>#</sup>	20(0.80)* (0.83) <sup>#</sup>
<b>4g</b>	12(0.35)* (0.38) <sup>#</sup>	14(0.48)* (0.53) <sup>#</sup>	12(0.34)* (0.41) <sup>#</sup>	16(0.72)* (0.76) <sup>#</sup>	18(0.85)* (0.78) <sup>#</sup>	21(0.84)* (0.87) <sup>#</sup>
<b>4h</b>	22(0.64)* (0.70) <sup>#</sup>	16(0.55)* (0.61) <sup>#</sup>	31(0.88)* (1.06) <sup>#</sup>	18(0.81)* (0.85) <sup>#</sup>	15(0.71)* (0.65) <sup>#</sup>	19(0.76)* (0.79) <sup>#</sup>
<b>4i</b>	14(0.41)* (0.45) <sup>#</sup>	18(0.62)* (0.69) <sup>#</sup>	21(0.60)* (0.72) <sup>#</sup>	12(0.54)* (0.57) <sup>#</sup>	16(0.76)* (0.69) <sup>#</sup>	15(0.60)* (0.62) <sup>#</sup>
Std. 1	34	29	35	22	21	25
Std. 2	31	26	29	21	23	24

a= concentration of test compounds and standard 100  $\mu$ g/mL,

b= average zone of inhibition in mm,

(Activity index) = Inhibition zone of the sample / Inhibition zone of the standard,

\* = Activity index against std. 1,

# = Activity index against std. 2,

for antibacterial activity: Std. 1 = Ciprofloxacin and Std. 2 = Sulphacetamide, for antifungal activity: Std. 1 = Gentamycin and Std. 2 = Clotrimazole.

**4-(4-hydroxybenzylidene)-2-(4-chloro styryl) oxazol-5-ones (2d).** Yield 58%; mp 245 °C (methanol); FT-IR (KBr)  $\text{cm}^{-1}$ : 3411 (phenolic -OH), 1675 (C=O), 1610 (C=C), 1511 (C=N) and 2988, 3068 (aro-

matic str.); <sup>1</sup>H-NMR (DMSO-*d*<sub>6</sub>)δ ppm: 4.86 (s, 1H, Ar-OH, exchangeable with D<sub>2</sub>O), 5.10 (d, 1H, CH=CH-Ar), 6.17 (1H, CH=CH-Ar), 7.14 (s, 1H, exocyclic vinylic); R<sub>f</sub>=0.57. Anal. Calcd for C<sub>18</sub>H<sub>12</sub>ClNO<sub>3</sub> (325) C, 66.37; H, 3.71; N, 4.30 found C, 66.38; H, 3.74; N, 4.33.

**4-(4-hydroxybenzylidene)-2-(2-methoxy styryl) oxazol-5-ones (2e).** Yield 68%; mp 215 °C (methanol); FT-IR (KBr) cm<sup>-1</sup>: 3320 (phenolic -OH), 1545 (C=N), 1589 (C=C), 1670 (C=O) and 2764, 3078 (aromatic str.); <sup>1</sup>H-NMR (DMSO-*d*<sub>6</sub>)δ ppm: 4.85 (s, 1H, Ar-OH exchangeable with D<sub>2</sub>O), 5.22 (d, 1H, CH=CH-Ar), 6.68 (1H, CH=CH-Ar), 7.2 (s, 1H, exocyclic vinylic); R<sub>f</sub>=0.55. Anal. Calcd for C<sub>19</sub>H<sub>15</sub>NO<sub>4</sub> (321) C, 71.02; H, 4.71; N, 4.36 found C, 71.05; H, 4.73; N, 4.32.

**4-(4-hydroxybenzylidene)-2-(3-methoxy styryl) oxazol-5-ones (2f).** Yield 67%; mp 225 °C (methanol); FT-IR (KBr) cm<sup>-1</sup>: 3410 (phenolic -OH), 1555 (C=N), 1615 (C=C), 1676 (C=O) and 2812, 3019 (aromatic str.); <sup>1</sup>H-NMR (DMSO-*d*<sub>6</sub>)δ ppm: 5.15 (s, 1H, Ar-OH exchangeable with D<sub>2</sub>O), 5.60 (d, 1H, CH=CH-Ar), 6.65 (1H, CH=CH-Ar), 7.18 (s, 1H, exocyclic vinylic); R<sub>f</sub>=0.58. Anal. Calcd for C<sub>19</sub>H<sub>15</sub>NO<sub>4</sub> (321) C, 71.02; H, 4.71; N, 4.36 found C, 71.00; H, 4.72; N, 4.40.

**4-(4-hydroxybenzylidene)-2-(4-methoxy styryl) oxazol-5-ones (2g).** Yield 68%; mp 190 °C (methanol); FT-IR (KBr) cm<sup>-1</sup>: 3422 (phenolic -OH), 1706 (C=O), 1561 (C=N), 1620 (C=C) and 2824, 3020 (aromatic str.); <sup>1</sup>H-NMR (DMSO-*d*<sub>6</sub>)δ ppm: 5.10 (s, 1H, Ar-OH exchangeable with D<sub>2</sub>O), 5.21 (d, 1H, CH=CH-Ar), 6.67 (1H, CH=CH-Ar), 7.20 (s, 1H, exocyclic vinylic); R<sub>f</sub>=0.62. Anal. Calcd for C<sub>19</sub>H<sub>15</sub>NO<sub>4</sub> (321) C, 71.02; H, 4.71; N, 4.36 found C, 71.05; H, 4.71; N, 4.34.

**4-(4-hydroxybenzylidene)-2-(3-nitro styryl) oxazol-5-ones (2h).** Yield 64%; mp 248 °C (methanol); FT-IR (KBr) cm<sup>-1</sup>: 3411 (phenolic -OH), 1665 (C=O), 1614 (C=C), 1535 (C=N) and 2754, 2995 (aromatic str.); <sup>1</sup>H-NMR (DMSO-*d*<sub>6</sub>)δ ppm: 5.25 (s, 1H, Ar-OH exchangeable with D<sub>2</sub>O), 5.18 (d, 1H, CH=CH-Ar), 6.70 (1H, CH=CH-Ar), 7.12 (s, 1H, exocyclic vinylic); R<sub>f</sub>=0.48. Anal. Calcd for C<sub>18</sub>H<sub>12</sub>N<sub>2</sub>O<sub>5</sub> (336) C, 64.29; H, 3.60; N, 8.33 found C, 64.32; H, 3.64; N, 8.32.

**4-(4-hydroxybenzylidene)-2-(4-dimethylamino styryl) oxazol-5-ones (2i).** Yield 55%; mp 187 °C (methanol); FT-IR (KBr) cm<sup>-1</sup>: 3387 (phenolic -OH), 1634 (C=O), 1552 (C=N), 1576 (C=C) and 2789, 2981 (aromatic str.); <sup>1</sup>H-NMR (DMSO-*d*<sub>6</sub>)δ ppm: 4.82 (s, 1H, Ar-OH exchangeable with D<sub>2</sub>O), 5.20 (d, 1H, CH=CH-Ar), 6.34 (1H, CH=CH-Ar), 7.22 (s, 1H, exocyclic vinylic); R<sub>f</sub>=0.56. Anal. Calcd for C<sub>20</sub>H<sub>18</sub>N<sub>2</sub>O<sub>3</sub> (334) C, 71.84; H, 5.43; N, 8.33 found C, 71.82; H, 5.45; N, 8.40.

**General preparation of 4-(4-*o*-β-*d*-tetra-*o*-acetyl-glucoxybenzylidene) 2-(substituted styryl) oxazol-5-ones (3a-i).** A mixture of 4-(4-hydroxybenzylidene)-2-(substituted styryl-oxazol-5-ones, (0.39 mmol), K<sub>2</sub>CO<sub>3</sub> (0.43 mmol), and acetonitrile (60 mL) was stirred at room temperature for 2 h under argon atmosphere. 18-Crown-6 (0.04 mmol) was added followed by α-glucopyranosyl bromide (0.58 mmol). After 5 h, it was poured onto ice cold water. It was neutralized with H<sub>2</sub>SO<sub>4</sub> (1 mol/L). The product was extracted in ethyl acetate (50 mL × 4). Removal of the volatiles under reduce pressure afforded a brown semisolid.

**4-(4-*o*-β-*d*-tetra-*o*-acetyl-glucoxybenzylidene)-2-styryl oxazol-5-ones (3a).** Yield 62%; [α]<sub>D</sub><sup>30</sup> = -10.55 (c 0.1, CH<sub>3</sub>OH); FT-IR (KBr) cm<sup>-1</sup>: 2910, 3030 (aromatic str.), 2868 (glucosidic-CH), 1610 (C=N), 1710 (C=O), 1088 (C-O-C); <sup>1</sup>H-NMR (400 MHz, DMSO-*d*<sub>6</sub>)δ ppm: 2.02, 1.92, 1.96, 2.15 (s, 3H, OAc), 5.10 (d, 1H, anomeric proton) 5.32 (d, 1H, CH=CH-Ar), 6.16 (d, CH=CH-Ar), 7.10 (s, 1H, exocyclic vinylic), 7.4-7.9 (m, 9H, Ar-H). Anal. Calcd for C<sub>32</sub>H<sub>31</sub>NO<sub>12</sub> (621) C, 61.83; H, 5.03; N, 2.25 found C, 61.80; H, 3.02; N, 2.28.

**4-(4-*o*- $\beta$ -d-tetra-*o*-acetyl-glucoxybenzylidene)-2-(2-chloro styryl) oxazol-5-ones (3b).** Yield 70%;  $[\alpha]_D^{30} = +13.11$  (c 0.1, CH<sub>3</sub>OH); FT-IR (KBr) cm<sup>-1</sup>: 2924, 3028 (aromatic str.), 2876 (glucosidic-CH), 1609 (C=N), 1625 (C=C), 1710 (C=O), 1089 (C-O-C); <sup>1</sup>H-NMR (400 MHz, DMSO-*d*<sub>6</sub>) $\delta$  ppm: 2.04, 1.93, 1.96, 2.17 (s, 3H, OAc), 5.4 (d, 1H, anomeric proton), 5.78 (d, 1H, CH=CH-Ar), 6.52 (d, CH=CH-Ar), 7.14 (s, 1H, exocyclic vinylic), 7.4-8.2 (m, 8H, Ar-H). Anal. Calcd for C<sub>32</sub>H<sub>30</sub>ClNO<sub>12</sub> (656) C, 58.59; H, 4.61; N, 2.14 found C, 58.60; H, 4.64; N, 2.16.

**4-(4-*o*- $\beta$ -d-tetra-*o*-acetyl-glucoxybenzylidene)-2-(3-chloro styryl) oxazol-5-ones (3c).** Yield 68%;  $[\alpha]_D^{30} = +9.00$  (c 0.1, CH<sub>3</sub>OH); FT-IR (KBr) cm<sup>-1</sup>: 2945, 3038 (aromatic str.), 2870 (glucosidic-CH), 1612 (C=N), 1560 (C=C), 1722 (C=O), 1078 (C-O-C); <sup>1</sup>H-NMR (400 MHz, DMSO-*d*<sub>6</sub>) $\delta$  ppm: 2.04, 1.94, 1.97, 2.20 (s, 3H, OAc), 5.10 (d, 1H, anomeric proton), 5.54 (d, 1H, CH=CH-Ar), 6.12 (d, CH=CH-Ar), 7.15 (s, 1H, exocyclic vinylic), 7.4-8.5 (m, 8H, Ar-H). Anal. Calcd for C<sub>32</sub>H<sub>30</sub>ClNO<sub>12</sub> (656) C, 58.59; H, 4.61; N, 2.14 found C, 58.62; H, 4.62; N, 2.18.

**4-(4-*o*- $\beta$ -d-tetra-*o*-acetyl-glucoxybenzylidene)-2-(4-chloro styryl) oxazol-5-ones (3d).** Yield 72%;  $[\alpha]_D^{30} = -14.12$  (c 0.1, CH<sub>3</sub>OH); FT-IR (KBr) cm<sup>-1</sup>: 2905, 3011 (aromatic str.), 2878 (glucosidic-CH), 1620 (C=N), 1726 (C=O), 1080 (C-O-C); <sup>1</sup>H-NMR (400 MHz, DMSO-*d*<sub>6</sub>) $\delta$  ppm: 2.00, 1.94, 1.96, 2.45 (s, 3H, OAc), 5.50 (d, 1H, anomeric proton), 5.88 (d, 1H, CH=CH-Ar), 6.35 (d, CH=CH-Ar), 7.20 (s, 1H, exocyclic vinylic), 7.6 to 8.8 (m, 8H, Ar-H). Anal. Calcd for C<sub>32</sub>H<sub>30</sub>ClNO<sub>12</sub> (656) C, 58.59; H, 4.61; N, 2.14 found C, 58.64; H, 4.63; N, 2.19.

**4-(4-*o*- $\beta$ -d-tetra-*o*-acetyl-glucoxybenzylidene)-2-(2-methoxy styryl) oxazol-5-ones (3e).** Yield 66%;  $[\alpha]_D^{30} = -21.44$  (c 0.1, CH<sub>3</sub>OH); FT-IR (KBr) cm<sup>-1</sup>: 2912, 3035 (aromatic str.), 2855 (glucosidic-CH), 1614 (C=N), 1714 (C=O), 1091 (C-O-C); <sup>1</sup>H-NMR (400 MHz, DMSO-*d*<sub>6</sub>) $\delta$  ppm: 2.04, 1.90, 1.95, 2.18 (s, 3H, OAc), 5.6 (d, 1H, anomeric proton), 5.92 (d, CH=CH-Ar), 6.69 (d, 1H, CH=CH-Ar), 7.18 (s, 1H, exocyclic vinylic), 7.6 to 8.6 (m, 8H, Ar-H). Anal. Calcd for C<sub>32</sub>H<sub>33</sub>NO<sub>13</sub> (651) C, 60.83; H, 5.10; N, 2.15 found C, 60.85; H, 5.10; N, 2.12.

**4-(4-*o*- $\beta$ -d-tetra-*o*-acetyl-glucoxybenzylidene)-2-(3-methoxy styryl) oxazol-5-ones (3f).** Yield 56%;  $[\alpha]_D^{30} = -20.11$  (c 0.1, CH<sub>3</sub>OH); FT-IR (KBr) cm<sup>-1</sup>: 2918, 3035 (aromatic str.), 2858 (glucosidic-CH), 1518 (C=N), 1610 (C=C), 1733 (C=O), 1089 (C-O-C); <sup>1</sup>H-NMR (400 MHz, DMSO-*d*<sub>6</sub>) $\delta$  ppm: 2.05, 1.92, 1.96, 2.20 (s, 3H, OAc), 5.7 (d, 1H, anomeric proton), 5.95 (d, 1H, CH=CH-Ar), 6.58 (d, CH=CH-Ar), 7.14 (s, 1H, exocyclic vinylic), 7.5 to 6.8 (m, 8H, Ar-H). Anal. Calcd for C<sub>32</sub>H<sub>33</sub>NO<sub>13</sub> (651) C, 60.83; H, 5.10; N, 2.15 found C, 60.83; H, 5.11; N, 2.11.

**4-(4-*o*- $\beta$ -d-tetra-*o*-acetyl-glucoxybenzylidene)-2-(4-methoxy styryl) oxazol-5-ones (3g).** Yield 66%;  $[\alpha]_D^{30} = -19.68$  (c 0.1, CH<sub>3</sub>OH); FT-IR (KBr) cm<sup>-1</sup>: 2902, 3030 (aromatic str.), 2852 (glucosidic-CH), 1612 (C=N), 1646 (C=C), 1740 (C=O), 1109 (C-O-C); <sup>1</sup>H-NMR (400 MHz, DMSO-*d*<sub>6</sub>) $\delta$  ppm: 2.01, 1.92, 1.93, 2.23 (s, 3H, OAc), 5.4 (d, 1H, anomeric proton), 5.78 (d, 1H, CH=CH-Ar), 6.56 (d, CH=CH-Ar), 7.15 (s, 1H, exocyclic vinylic), 7.3 to 8.2 (m, 8H, Ar-H). Anal. Calcd for C<sub>32</sub>H<sub>33</sub>NO<sub>13</sub> (651) C, 60.83; H, 5.10; N, 2.15 found C, 60.80; H, 5.10; N, 2.19.

**4-(4-*o*- $\beta$ -d-tetra-*o*-acetyl-glucoxybenzylidene)-2-(3-nitro styryl) oxazol-5-ones (3h).** Yield 69%;  $[\alpha]_D^{30} = -14.25$  (c 0.1, CH<sub>3</sub>OH); FT-IR (KBr) cm<sup>-1</sup>: 2912, 3108 (aromatic str.), 2871 (glucosidic-CH), 1615 (C=N), 1648 (C=C), 1710 (C=O), 1088 (C-O-C); <sup>1</sup>H-NMR (400 MHz, DMSO-*d*<sub>6</sub>) $\delta$  ppm: 2.02, 1.95, 1.97,



2.19 (s, 3H, OAc), 5.6 (d, 1H, anomeric proton), 5.88 (d, 1H, CH=CH-Ar), 6.30 (d, CH=CH-Ar), 7.22 (s, 1H, exocyclic vinylic), 7.8 to 8.5 (m, 8H, Ar-H). Anal. Calcd for C<sub>32</sub>H<sub>30</sub>N<sub>2</sub>O<sub>14</sub> (666) C, 57.66; H, 4.54; N, 4.20 found C, 57.68; H, 4.56; N, 4.22.

**4-(4-*o*- $\beta$ -d-tetra-*o*-acetyl-glucoxybenzylidene)-2-(4-dimethylamino styryl) oxazol-5-ones (3i).** Yield 62%;  $[\alpha]_D^{30} = -16.40$  (c 0.1, CH<sub>3</sub>OH); FT-IR (KBr) cm<sup>-1</sup>: 2922, 3034 (aromatic str.), 2880 (glucosidic-CH), 1627 (C=N), 1635 (C=C), 1768 (C=O), 1079 (C-O-C); <sup>1</sup>H-NMR (400 MHz, DMSO-*d*<sub>6</sub>) $\delta$  ppm: 2.11, 1.97, 1.95, 2.10 (s, 3H, OAc), 5.5 (d, 1H, anomeric proton), 5.94 (d, 1H, CH=CH-Ar), 6.68 (d, CH=CH-Ar), 7.18 (s, 1H, exocyclic vinylic), 7.6 to 8.5 (m, 8H, Ar-H). Anal. Calcd for C<sub>34</sub>H<sub>36</sub>N<sub>2</sub>O<sub>12</sub> (664) C, 61.44; H, 5.46; N, 4.21 found C, 61.47; H, 5.48; N, 4.28.

**General preparation of 4-(4-*o*- $\beta$ -d-glucoxybenzylidene)-2-(substituted styryl) oxazol-5-ones (4a-i).** A mixture of 4-(4-*o*- $\beta$ -d-tetra-*o*-acetyl-glucoxybenzylidene)-2-styryl oxazol-5-ones (0.109 mmol), dry methanol (2 mL), and anhydrous zinc acetate (0.126 mmol) was refluxed for 7 h. After being cooled down at room temperature, it was filtered through cation exchanged resin; the solvent was removed under vacuum. The residue was purified by silica gel chromatography (CHCl<sub>3</sub>, MeOH, 12:1 v/v) to get the title compound in brown semisolid form.

**4-(4-*o*- $\beta$ -d-glucoxybenzylidene)-2-styryl oxazol-5-ones (4a).** Yield 66%;  $[\alpha]_D^{30} = -14.11$  (c 0.1, DMSO); FT-IR(KBr) cm<sup>-1</sup>: 3405 (intramolecular -OH, broad, carbohydrate group), 2956 (glucosidic -CH), 2789 (Ar-CH), 1612 (C=N), 1645 (C=C), 1252 (C-N), 1028 (C-O-C); <sup>1</sup>H-NMR (400 MHz, DMSO-*d*<sub>6</sub>) $\delta$  ppm: 3.0 (1H, 5'H), 3.6 (1H, 4'H), 3.5 (1H, 3'H), 3.9 (1H, 2'H), 5.2 (s, 1H) anomeric proton, 5.60 (d, 1H, =CH-Ar), 6.60 (1H, CH=CH-Ar), 7.20 (s, 1H, exocyclic vinylic), 7.40 to 8.22 (m, 8H, Ar-H); <sup>13</sup>C-NMR (100 MHz, DMSO-*d*<sub>6</sub>)  $\delta$  ppm: 138-115 (Ar-C), sugar moiety:  $\delta$  102.2 (s, C-1') anomeric carbon, 82 (s, C-6'), 74 (s, C-5'), 69.5 (s, C-4'), 70.0 (s, C-3'), 61(s, C-2'); MS (EI, 70 ev): 453 (M) (15%), 290 (100%) base peak, 273 (18%), 188 (14%), 163 (6%), 80(13%). Anal. Calcd for C<sub>24</sub>H<sub>23</sub>NO<sub>8</sub> (453) C, 63.57; H, 5.11; N, 3.09 found C, 63.50; H, 5.10; N, 3.11.

**4-(4-*o*- $\beta$ -d-glucoxybenzylidene)-2-(2-chloro styryl) oxazol-5-ones (4b).** Yield 76%;  $[\alpha]_D^{30} = +15.35$  (c 0.1, DMSO); FT-IR (KBr) cm<sup>-1</sup>: 3415 (intramolecular -OH, broad, carbohydrate group), 2926 (glucosidic -CH), 2785 (Ar-CH), 1610 (C=N), 1632 (C=C), 1244 (C-N), 1033 (C-O-C); <sup>1</sup>H-NMR (400 MHz, DMSO-*d*<sub>6</sub>) $\delta$  ppm: 3.2 (1H, 5'H), 3.8 (1H, 4'H), 3.4 (1H, 3'H), 3.9 (1H, 2'H), 5.52 (s, 1H) anomeric proton, 5.90 (d, 1H, CH=CH-Ar), 6.45 (1H, CH=CH-Ar), 7.12 (s, 1H, exocyclic vinylic), 7.4 to 8.6 (m, 8H, Ar-H); <sup>13</sup>C-NMR (100 MHz, DMSO-*d*<sub>6</sub>) $\delta$  ppm: 131.2-116.6 (Ar-C), sugar moiety:  $\delta$  100.8 (s, C-1') anomeric carbon, 77 (s, C-6'), 72 (s, C-5'), 70.5 (s, C-4'), 72.4 (s, C-3'), 64 (s, C-2'); MS (EI, 70 ev): 487 (M) (15%), 324 (15%), 180 (100%) base peak, 165 (15%), 163 (10%), 79 (31%). Anal. Calcd for C<sub>24</sub>H<sub>22</sub>ClNO<sub>8</sub> (487) C, 59.08; H, 4.55; N, 2.87 found C, 59.10; H, 4.58; N, 2.85.

**4-(4-*o*- $\beta$ -d-glucoxybenzylidene)-2-(3-chloro styryl) oxazol-5-ones (4c).** Yield 71%;  $[\alpha]_D^{30} = -10.11$ (c 0.1, DMSO); FT-IR (KBr) cm<sup>-1</sup>: 3420 (intramolecular -OH, broad, carbohydrate group), 2928 (glucosidic -CH), 2788 (Ar-CH), 1621 (C=N), 1655 (C=C), 1245 (C-N), 1034 (C-O-C); <sup>1</sup>H-NMR (400 MHz, DMSO-*d*<sub>6</sub>) $\delta$  ppm: 3.2 (1H, 5'H), 3.7 (1H, 4'H), 3.4 (1H, 3'H), 3.8 (1H, 2'H), 5.25 (s, 1H) anomeric proton, 5.84 (d, 1H, CH=CH-Ar), 6.42 (1H, CH=CH-Ar), 7.15 (s, 1H, exocyclic vinylic), 7.3 to 8.4 (m, 8H, Ar-H); <sup>13</sup>C-NMR (100 MHz, DMSO-*d*<sub>6</sub>) $\delta$  ppm: 132.4-115 (Ar-C), sugar moiety:  $\delta$  101.0 (s, C-1') anomeric carbon, 75 (s, C-6'), 71

(s, C-5'), 70.5 (s, C-4'), 72.6 (s, C-3'), 65 (s, C-2'); MS (EI, 70 ev): 487 (M) (10%), 326 (11%), 181 (100%) base peak, 160 (18%), 163 (14%), 78 (30%). Anal. Calcd for C<sub>24</sub>H<sub>22</sub>ClNO<sub>8</sub> (487) C, 59.08; H, 4.55; N, 2.87 found C, 59.11; H, 4.52; N, 2.87.

**4-(4-*o*- $\beta$ -d-glucoxybenzylidene)-2-(4-chloro styryl) oxazol-5-ones (4d).** Yield 59%;  $[\alpha]_D^{30} = -18.25$  (c 0.1, DMSO); FT-IR(KBr) cm<sup>-1</sup>: 3510 (intramolecular -OH, broad, carbohydrate group), 2930 (glucosidic -CH), 2780 (Ar-CH), 1612 (C=N), 1578 (C=C), 1245 (C-N), 1035 (C-O-C); <sup>1</sup>H-NMR (400 MHz, DMSO-*d*<sub>6</sub>) $\delta$  ppm: 3.2 (1H, 5'H), 3.7 (1H, 4'H), 3.4 (1H, 3'H), 3.8 (1H, 2'H), 5.28 (s, 1H) anomeric proton, 5.58 (d, 1H, CH=CH-Ar), 6.62 (1H, CH=CH-Ar), 7.20 (s, 1H, exocyclic vinylic), 7.5 to 8.3 (m, 8H, Ar-H); <sup>13</sup>C-NMR (100 MHz, DMSO-*d*<sub>6</sub>) $\delta$  ppm: 132-117.2 (Ar-C), sugar moiety:  $\delta$  102.0 (s, C-1') anomeric carbon, 75 (s, C-6'), 72 (s, C-5'), 70.4 (s, C-4'), 71.4 (s, C-3'), 68 (s, C-2'); MS (EI, 70 ev): 487 (M) (18%), 322 (26%), 130 (100%) base peak, 168 (10%), 163 (14%), 77 (31%). Anal. Calcd for C<sub>24</sub>H<sub>22</sub>ClNO<sub>8</sub> (487) C, 59.08; H, 4.55; N, 2.87 found C, 59.05; H, 4.55; N, 2.83.

**4-(4-*o*- $\beta$ -d-glucoxybenzylidene)-2-(2-methoxy styryl) oxazol-5-ones (4e).** Yield 78%;  $[\alpha]_D^{30} = -28.34$  (c 0.1, DMSO); FT-IR(KBr) cm<sup>-1</sup>: 3505 (intramolecular -OH, broad, carbohydrate group), 2966 (glucosidic -CH), 2785 (Ar-CH), 1618 (C=N), 1625 (C=C), 1238 (C-N), 1055 (C-O-C); <sup>1</sup>H-NMR (400 MHz, DMSO-*d*<sub>6</sub>) $\delta$  ppm: 3.3 (1H, 5'H), 3.6 (1H, 4'H), 3.5 (1H, 3'H), 3.8 (1H, 2'H), 5.2 (s, 1H) anomeric proton, 5.9 (d, 1H, CH=CH-Ar), 6.65 (1H, CH=CH-Ar), 7.24 (s, 1H, exocyclic vinylic), 7.5 to 8.8 (m, 8H, Ar-H); <sup>13</sup>C-NMR (100 MHz, DMSO-*d*<sub>6</sub>) $\delta$  ppm: 107-130 (Ar-C), sugar moiety:  $\delta$  101.4 (s, C-1') anomeric carbon, 78 (s, C-6'), 73 (s, C-5'), 72.5 (s, C-4'), 73.1 (s, C-3'), 62 (s, C-2'); MS (EI, 70ev): 483 (M) (11%), 320 (15%), 215 (100%) base peak, 185 (28%), 130 (10%), 118 (24%). Anal. Calcd for C<sub>25</sub>H<sub>25</sub>NO<sub>9</sub> (483) C, 62.11; H, 5.21; N, 2.90 found C, 62.08; H, 5.24; N, 2.85.

**4-(4-*o*- $\beta$ -d-glucoxybenzylidene)-2-(3-methoxy styryl) oxazol-5-ones (4f).** Yield 74%;  $[\alpha]_D^{30} = -26.56$  (c 0.1, DMSO); FT-IR(KBr) cm<sup>-1</sup>: 3420 (intramolecular -OH, broad, carbohydrate group), 2968 (glucosidic -CH), 2780 (Ar-CH), 1622 (C=N), 1620 (C=C), 1236 (C-N), 1056 (C-O-C); <sup>1</sup>H-NMR (400 MHz, DMSO-*d*<sub>6</sub>) $\delta$  ppm: 3.2 (1H, 5'H), 3.4 (1H, 4'H), 3.5 (1H, 3'H), 3.6 (1H, 2'H), 5.30 (s, 1H) anomeric proton, 5.82 (d, 1H, CH=CH-Ar), 6.66 (1H, CH=CH-Ar), 7.18 (s, 1H, exocyclic vinylic), 7.4 to 8.7 (m, 8H, Ar-H); <sup>13</sup>C-NMR (100 MHz, DMSO-*d*<sub>6</sub>) $\delta$  ppm: 107-128 (Ar-C), sugar moiety:  $\delta$  103.5 (s, C-1') anomeric carbon, 78 (s, C-6'), 74 (s, C-5'), 73.5 (s, C-4'), 75.1 (s, C-3'), 64 (s, C-2'); MS (EI, 70ev): 483 (M) (20%), 320 (18%), 175 (30%), 145 (100%) base peak, 130 (12%), 116 (0.8%). Anal. Calcd for C<sub>25</sub>H<sub>25</sub>NO<sub>9</sub> (483) C, 62.11; H, 5.21; N, 2.90 found C, 62.14; H, 5.19; N, 2.86.

**4-(4-*o*- $\beta$ -d-glucoxybenzylidene)-2-(4-methoxy styryl) oxazol-5-ones (4g).** Yield 66%;  $[\alpha]_D^{30} = -22.19$  (c 0.1, DMSO); FT-IR (KBr) cm<sup>-1</sup>: 3368 (intramolecular -OH, broad, carbohydrate group), 2980 (glucosidic -CH), 2778 (Ar-CH), 1620 (C=N), 1644 (C=C), 1242 (C-N), 1058 (C-O-C); <sup>1</sup>H-NMR (400 MHz, DMSO-*d*<sub>6</sub>) $\delta$  ppm: 3.2 (1H, 5'H), 3.4 (1H, 4'H), 3.6 (1H, 3'H), 3.7 (1H, 2'H), 5.42 (s, 1H) anomeric proton, 5.94 (d, 1H, CH=CH-Ar), 6.65 (1H, CH=CH-Ar), 7.16 (s, 1H, exocyclic vinylic), 7.4 to 8.6 (m, 8H, Ar-H); <sup>13</sup>C-NMR (100 MHz, DMSO-*d*<sub>6</sub>) $\delta$  ppm: 107-128 (Ar-C), sugar moiety:  $\delta$  102.0 (s, C-1') anomeric carbon, 70 (s, C-6'), 74 (s, C-5'), 75 (s, C-4'), 78.5 (s, C-3'), 65 (s, C-2'); MS (EI, 70 ev): 483 (M) (22%), 320 (15%), 188 (21%), 165 (100%) base peak, 118 (12%), 77 (20%). Anal. Calcd for C<sub>25</sub>H<sub>25</sub>NO<sub>9</sub> (483) C, 62.11; H, 5.21; N, 2.90 found C, 62.14; H, 5.19; N, 2.89.

**4-(4-*o*- $\beta$ -d-glucoxybenzylidene)-2-(3-nitro styryl) oxazol-5-ones (4h).** Yield 72%;  $[\alpha]_D^{30} = -15.10$  (c 0.1, DMSO); FT-IR (KBr)  $\text{cm}^{-1}$ : 3410 (intramolecular -OH, broad, carbohydrate group), 2950 (glucosidic -CH), 2807 (Ar-CH), 1616 (C=N), 1612 (C=C), 1249 (C-N), 1068 (C-O-C);  $^1\text{H-NMR}$  (400 MHz, DMSO- $d_6$ ) $\delta$  ppm: 2.9 (1H, 5'H), 3.0 (1H, 4'H), 3.4 (1H, 3'H), 3.9 (1H, 2'H), 5.40 (s, 1H) anomeric proton, 5.82 (d, 1H, CH=CH-Ar), 6.56 (1H, CH=CH-Ar), 7.12 (s, 1H, exocyclic vinylic), 7.7 to 8.7 (m, 8H, Ar-H);  $^{13}\text{C-NMR}$  (100 MHz, DMSO- $d_6$ ) $\delta$  ppm: 110-134 (Ar-C), sugar moiety:  $\delta$  103.0 (s, C-1') anomeric carbon, 78 (s, C-3'), 64 (s, C-2'); MS (El, 70 ev): 498 (M) (15%), 336 (100%) base peak, 292 (13%), 190 (15%), 163 (8%), 78 (11%). Anal. Calcd for  $\text{C}_{24}\text{H}_{22}\text{N}_2\text{O}_{10}$  (498) C, 57.83; H, 4.45; N, 5.62 found C, 57.85; H, 4.48; N, 5.65.

**4-(4-*o*- $\beta$ -d-glucoxybenzylidene)-2-(4-dimethylamino styryl) oxazol-5-ones (4i).** Yield 60%;  $[\alpha]_D^{30} = -18.65$  (c 0.1, DMSO); FT-IR (KBr)  $\text{cm}^{-1}$ : 3385 (intramolecular -OH, broad, carbohydrate group), 2960 (glucosidic -CH), 2778 (Ar-CH), 1610 (C=N), 1624 (C=C), 1255 (C-N), 1088 (C-O-C);  $^1\text{H-NMR}$  (400 MHz, DMSO- $d_6$ ) $\delta$  ppm: 3.1 (1H, 5'H), 3.7 (1H, 4'H), 3.6 (1H, 3'H), 3.9 (1H, 2'H), 5.2 (s, 1H) anomeric proton, 5.7 (d, 1H, CH=CH-Ar), 6.12 (1H, CH=CH-Ar), 7.25 (s, 1H, exocyclic vinylic), 7.5 to 8.7 (m, 8H, Ar-H);  $^{13}\text{C-NMR}$  (100 MHz, DMSO- $d_6$ ) $\delta$  ppm: 114-128 (Ar-C), sugar moiety:  $\delta$  105.0 (s, C-1') anomeric carbon, 78 (s, C-6'), 76 (s, C-5'), 70.5 (s, C-4'), 70.0 (s, C-3'), 63 (s, C-2'); MS (El, 70 ev): 496 (M) (15%), 332 (16%), 270 (28%), 185 (100%) base peak, 163 (6%), 74 (10%). Anal. Calcd for  $\text{C}_{26}\text{H}_{28}\text{N}_2\text{O}_8$  (496) C, 62.89; H, 5.68; N, 5.64 found C, 62.87; H, 5.60; N, 5.61.

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