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RESEARCH ARTICLE
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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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ABSTRACT

The 4-(4-hydroxybenzylidene)-2-methyl oxazol-5-ones 1 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 by using α-acetobromoglucose as a glucosyl donor to affords 4-(4-o-β-d-tetra-o-acetyl- glucoxybenzylidene)-2-(substituted styryl) oxazol-5-ones 3a-i which was deacetylated by using Zinc acetate in absolute methanol to formed 4-(4-o-β-d-glucoxybenzylidene)-2-(substituted styryl) oxazol-5-ones 4a-i. Compounds showed good antimicrobial and antifungal activity.

Keywords: *Oxazolone, α - acetobromoglucose, decetylation, o -glucosides, antimicrobial and antifungal activity.*

INTRODUCTION

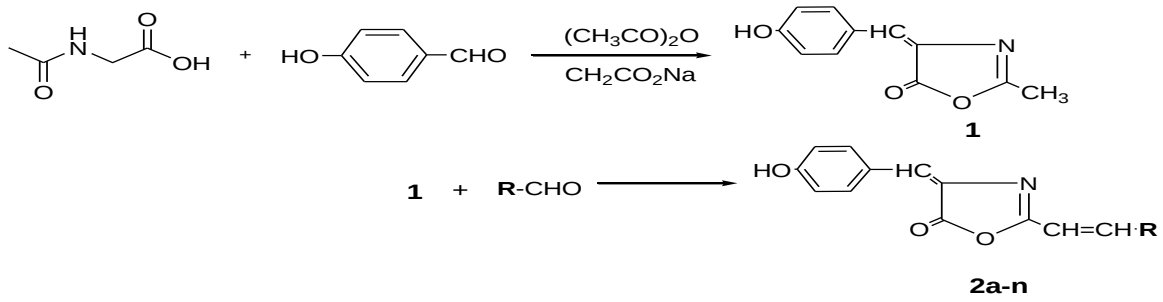
Heterocyclic compounds are widely distributed in nature and are essential for life. They play a vital role in the metabolism of all living cells. There are vast numbers of pharmacologically active heterocyclic compounds, many of which are in regular clinical use. Oxazoles play very vital role in the manufacturing of various biologically active drugs as anti-inflammatory, antidepressant, fluorescent whitening agent, scintillator properties, analgesics, etc.[1-8] Glucoconjugates and carbohydrates containing structure exhibit variety of biological and therapeutic properties.

Glycosides have a wide range of biological activities including antibacterial, antifungal, antiviral, anticancer, and antitumor activities.[9-12]

Thus keeping in view of pharmacological activity of oxazole, importance of glucoside in metabolism and continuation of our works[13] 4-(4-*O*-β-D-glucoxybenzylidene)-2-(substituted styryl) oxazol-5-ones have been synthesized. Besides some of the compounds are evaluated for their biological activity.

RESULT AND DISCUSSION

The starting compound 4-(4-hydroxybenzylidene)-2-methyl oxazol-5-ones **1** have been synthesized by using known methods [14] from acetylglycine and *p*-hydroxy benzaldehyde.Thus compound **1** reacted with various aldehyde in the presence of acetic acid to formed 4-(4-hydroxybenzylidene)-2-(substituted styryl) oxazol-5-ones **2a-i**. The IR spectrum of **2a** shows a broad peak 3430 (-OH), due to the presence of phenolic –OH group, 1510 (C=N), 1554 (C=C), 1701 (C=O), 3010, 3085 (Ar-CH). ^{1}H-NMR δ 5.15 (s, 1H, Ar-OH, exchangeable with D_2O), δ 5.20 (d, 1H, CH=CH-Ar), δ 6.80 (d, 1H, CH=CH-Ar), δ 7.20 the signal due to exocyclic vinylic proton.



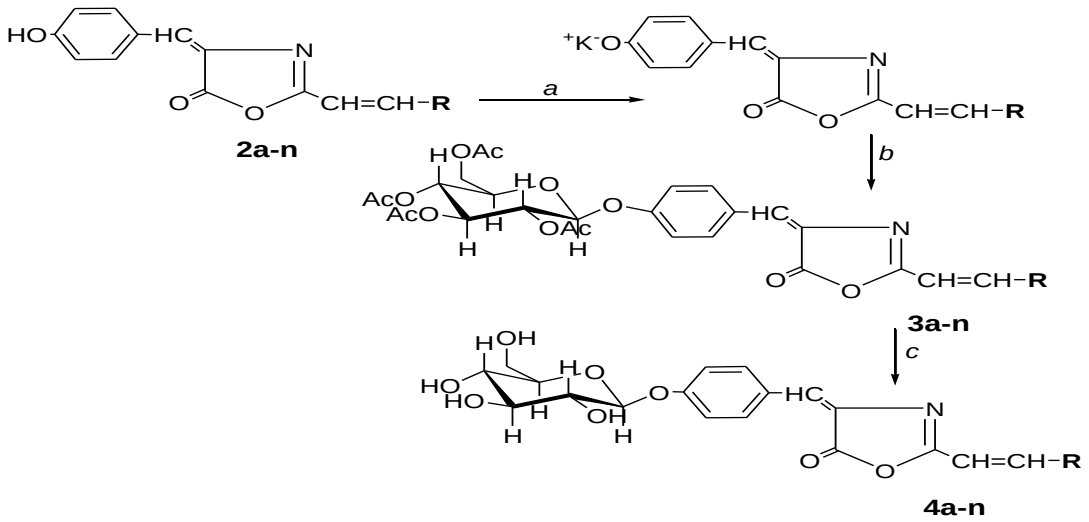
R =

a) C_6H_5 **b)** 2-Cl C_6H_4 **c)** 3-Cl C_6H_4 **d)** 4-Cl C_6H_4

e) 2-(OCH_3) C_6H_4 **f)** 3-(OCH_3) C_6H_4 **g)**4-(OCH_3) C_6H_4 **h)** 3-NO_2 C_6H_4, **i)**4-N $(CH_3)_2C_6H_5$

SCHEME 1: Synthesis of 4-(4 -hydroxybenzylidene)-2-(substituted styryl) oxazol-5-ones.

Glucosylation[15] of the product **2a-i** were carried out by using α-glucopyranosyl bromide which was prepared from bromination of glucose pentacetate.The potassium salt of **2a-i** has been carried out using argon atmosphere in dry acetonitrile in the presence of 18-crown-6 ether as a catalyst. The salt of aglycon and α-glucopyranosyl bromide use for the glucosylation to afford , 4-(4-*O*-β-D-tetra-*O*-acetyl-glucoxybenzylidene)-2-(substituted styryl) oxazol-5-ones **3a-i**.The compound obtained in good yield and it is confirmed by absence of phenolic -OH group at 3454 and the presence of 1610 (C=N), 1710 (C=O), 1088 was attributed to C-O-C stretch α-anomer of acetylated **3a** is confirmed by ^{1}H-NMR, the anomeric proton 1-H resonated as a doublet at δ 5.10 with coupling constant $J_{1\text{-}2}$=3.2Hz establishing the α-stereochemistry of the glucosidic bond. Further, 4-(4-*O*-β-D-tetra-*O*-acetyl-glucoxybenzylidene)-2-(substituted styryl) oxazol-5-ones undergo deacetylation [16] by using zinc acetate and absolute methanol (Scheme-2) to form 4-(4-*O*-β-D-glucoxybenzylidene)-2-(substituted styryl) oxazol-5-ones **4a-i**. IR spectra of **4a** showed broad band 3405 cm^{-1} (intramolecular –OH, broad, stretch) indicates the presence of carbohydrate hydroxyl group, 1612 (C=N) and C-N observed at 1252 cm^{-1}. The β-D-glucopyranosyl ring observed band at 1028 cm^{-1} which confirmed the formation of *O* -glucosides.The ^{1}H-NMR display a signal due to sugar proton between δ 3.1 to 4.0 ppm. The β-anomeric configuration was established by the appearance of doublet δ 5.2 ppm, aromatic ring proton between 7.4 to 8.20 ppm, 5.6 (1H, CH=CH-Ar), 6.6 ppm (1H, CH=CH-Ar), δ 7.20 (s, 1H, exocyclic vinylic). In 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) which 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 assigned structure.



R =

a) C_6H_5 **b)** 2-Cl C_6H_4 **c)** 3-Cl C_6H_4 **d)** 4-Cl C_6H_4

e) 2-(OCH_3) C_6H_4 **f)** 3-(OCH_3) C_6H_4 **g)**4-(OCH_3) C_6H_4 **h)** 3-NO_2 C_6H_4, **i)**4-N $(CH_3)_2C_6H_5$

SCHEME 2: 4-(4-*O*-β-D-glucoxybenzylidene)-2-(substituted styryl) oxazol-5-ones (*a*) K_2CO_3, CH_3CN, argon atmosphere; (*b*) □-glucopyranosyl bromide, 18-crown-6; (*c*) $Zn(OAc)_2$, MeOH.

Biological Activity

Antibacterial Activity

The synthesized compounds were screened for their antibacterial activities against pathogenic bacteria such as *Escherichia coli, Staphylococcus aurus, Bacillus subtillis*, and *Klebisilla aerogens* using cup plate diffusion method. The test compounds were dissolved in methanol at concentration 100 µg/mL by using Ciprofloxacin, Sulphacetamide as a standard drug.

Antifungal Activity

The synthesized compounds were also screened for their antifungal activity against *Aspergillus niger* and *Candida albicans* using cup plate diffusion method by dissolving methanol at concentration at 100 µg/mL. The zone of inhibition is at after 7 days and 20^0C and it was compared with Gentamycin and Clotrimazole as a standard drug as shown in Table-1.

Experimental

FT-IR spectra recorded KBr disc on Perkin-Elmer infra red spectrophotometer, ^{1}H-NMR and ^{13}C-NMR were obtained from Bruker II-400 NMR spectrophotometer (^{1}H, 400MHz and ^{13}C, 100 MHz) using TMS as an internal standard in DMSO-d_6, Mass spectra recorded on 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 determined using the FLASH EA 1112 CHN analyzer, Thermo Finngen, Italy. The 4-(4-hydroxybenzylidene)-2-methyl oxazol-5-ones **1** was prepared by using known procedure.

General procedure for the preparation of 4-(4-hydroxybenzylidene)-2-(substituted styryl) oxazol-5-ones [17] ***(2a)***

4-(4-Hydroxybenzylidene)-2-methyl oxazol-5-ones **1** (0.01mole) was refluxed with benzaldehyde (0.01mole) in glacial acetic acid (10 mL) for 2 h on sand bath. Completion of reaction was tested by TLC. The reaction mixture was poured on crushed ice; the residue was filtered, washed with acetic acid. The crude product was crystallize from methanol to get 4-(4 -hydroxybenzylidene) -2 styryl oxazol-5-ones **2a** yield 65 %; mp 260^0C. FT-IR (KBr) 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}H-NMR (DMSO-d_6) δ ppm: 5.15 (s, 1H, Ar-OH,

exchangeable with D_2O), 5.20 (d, 1H, CH=CH-Ar),6.80 (1H, CH=CH-Ar),7.20 (s, 1H, exocyclic vinylic). Anal. Calcd for $C_{18}H_{13}NO_3$ (291) C, 74.22; H, 4.50; N, 4.81 found C, 74.26; H, 4.48; N, 4.82, R_f =0.68.Similarly, all the compound **2a-i** was synthesized by using this method and spectral data some compounds are given as follows.

4-(4-hydroxybenzylidene)-2-(2-chloro styryl) oxazol-5-ones (2b)

Yield 70%; mp 238^0 C (methanol); FT-IR (KBr) cm^{-1}: 3450 (phenolic -OH), 2978,3019 (aromatic str.), 1695 (C=O), 1532 (C=N) 1568(C=C) ; ^{1}H-NMR(DMSO-d_6) δ ppm: 5.05 (s, 1H, Ar-OH, exchangeable with D_2O), 5.16 (d, 1H, CH=CH-Ar), 6.84 (d, 1H, CH=CH-Ar), 7.12 (s, 1H, exocyclic vinylic); R_f=0.67. Anal. Calcd for $C_{18}H_{12}ClNO_3$ (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 230^0 C (methanol); FT-IR(KBr) cm^{-1}: 3350 (phenolic -OH), 1666 (C=O), 1512 (C=N),1568(C=C) and 2755, 2885 (aromatic str.); ^{1}H-NMR (DMSO-d_6) δ ppm: 4.85 (s, 1H, Ar-OH, exchangeable with D_2O), 5.12 (d, 1H, CH=CH-Ar), 6.80 (1H, CH=CH-Ar), 7.20 (s, 1H, exocyclic vinylic); R_f=0.54. Anal. Calcd for $C_{18}H_{12}ClNO_3$ (325) C, 66.37; H, 3.71; N, 4.30 found C, 66.35; H, 3.69; N, 4.32.

4-(4-hydroxybenzylidene)-2-(4-chloro styryl) oxazol-5-ones (2d)

Yield 58%; mp 245^0 C (methanol); FT-IR(KBr) cm^{-1}: 3411 (phenolic -OH), 1675 (C=O), 1610 (C=C), 1511 (C=N) and 2988, 3068 (aromatic str.); ^{1}H-NMR (DMSO-d_6) δ ppm:4.86 (s, 1H, Ar-OH, exchangeable with D_2O),5.10 (d, 1H, CH=CH-Ar), 6.17 (1H, CH=CH-Ar),7.14 (s, 1H, exocyclic vinylic); R_f=0.57. Anal. Calcd for $C_{18}H_{12}ClNO_3$ (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 215^0 C (methanol); FT-IR(KBr) cm^{-1}: 3320 (phenolic -OH), 1545 (C=N) ,1589 (C=C), 1670 (C=O) and 2764, 3078 (aromatic str.); ^{1}H-NMR (DMSO-d_6) δ ppm :4.85 (s, 1H, Ar-OH exchangeable with D_2O), 5.22 (d, 1H, CH=CH-Ar), 6.68 (1H, CH=CH-Ar), 7.2 (s, 1H, exocyclic vinylic); R_f=0.55. Anal. Calcd for $C_{19}H_{15}NO_4$ (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 225^0 C (methanol); FT-IR(KBr) cm^{-1}: 3410 (phenolic -OH), 1555 (C=N), 1615 (C=C), 1676 (C=O) and 2812, 3019 (aromatic str.); ^{1}H-NMR (DMSO-d_6) δ ppm :5.15 (s, 1H, Ar-OH exchangeable with D_2O), 5.60 (d, 1H, CH=CH-Ar), 6.65 (1H, CH=CH-Ar), 7.18 (s, 1H, exocyclic vinylic); R_f=0.58. Anal. Calcd for $C_{19}H_{15}NO_4$ (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 190^0 C (methanol); FT-IR(KBr) cm^{-1}: 3422 (phenolic -OH), 1706 (C=O), 1561 (C=N),1620 (C=C) and 2824, 3020 (aromatic str.); ^{1}H-NMR (DMSO-d_6) δ ppm :5.10 (s, 1H, Ar-OH exchangeable with D_2O), 5.21 (d, 1H,CH=CH-Ar), 6.67 (1H, CH=CH-Ar), 7.20 (s, 1H, exocyclic vinylic); R_f=0.62. Anal. Calcd for $C_{19}H_{15}NO_4$ (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 248^0 C (methanol); FT-IR(KBr) cm^{-1}: 3411 (phenolic -OH), 1665 (C=O), 1614 (C=C), 1535 (C=N) and 2754, 2995 (aromatic str.); ^{1}H-NMR (DMSO-d_6) δ ppm : 5.25 (s, 1H, Ar-OH exchangeable with D_2O), 5.18 (d, 1H, CH=CH-Ar), 6.70 (1H, CH=CH-Ar), 7.12(s, 1H, exocyclic vinylic); R_f=0.48. Anal. Calcd for $C_{18}H_{12}N_2O_5$ (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-dimethyamino styryl) oxazol-5-ones (2i)

Yield 55%; mp 187^0 C (methanol); FT-IR(KBr) cm^{-1}: 3387 (phenolic -OH), 1634 (C=O), 1552 (C=N),1576 (C=C) and 2789, 2981 (aromatic str.); ^{1}H-NMR (DMSO-d_6) δ ppm : 4.82 (s, 1H, Ar-OH exchangeable with D_2O), 5.20 (d, 1H, CH=CH-Ar), 6.34 (1H, CH=CH-Ar), 7.22 (s, 1H, exocyclic vinylic); R_f=0.56. Anal. Calcd for

$C_{20}H_{18}N_2O_3$ (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, (0.39mmole), K_2CO_3 (0.43mmole) and acetonitrile (60 mL) was stirred at room temperature for 2 h under argon atmosphere.18-Crown-6 (0.04 mmole) was added followed by □-glucopyranosyl bromide (0.58 mmole). After 5h, it was poured on to ice cold water. It was neutralized with H_2SO_4 (1 mole/L). The product was extracted in ethyl acetate (50 mL x 4). Remove 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%; $[\alpha]_D^{30}$=-10.55 (c 0.1, CH_3OH); FT-IR(KBr) cm^{-1}: 2910, 3030 (aromatic str.), 2868 (glucosidic-CH), 1610 (C=N), 1710 (C=O), 1088 (C-O-C); ^{1}H-NMR (400 MHz, DMSO-d_6) 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 $C_{32}H_{31}NO_{12}$ (621) C, 61.83; H, 5.03; N, 2.25 found C, 61.80; H, 3.02; N, 2.28.

4-(4-o-β-d-tetra-o-acetyl-glucoxybenzylidene)-2-(2-chloro styryl) oxazol-5-ones (3b)

Yield 70%; $[\alpha]_D^{30}$ =+13.11(c 0.1, CH_3OH); FT-IR(KBr) cm^{-1}: 2924, 3028 (aromatic str.), 2876 (glucosidic-CH), 1609 (C=N), 1625(C=C),1710 (C=O), 1089 (C-O-C); ^{1}H-NMR (400 MHz, DMSO-d_6) δ 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 $C_{32}H_{30}ClNO_{12}$ (656) C, 58.59; H, 4.61; N, 2.14 found C, 58.60; H, 4.64; N, 2.16.

4-(4-o-β-d-tetra-o-acetyl-glucoxybenzylidene)-2-(3-chloro styryl) oxazol-5-ones (3c)

Yield 68%; $[\alpha]_D^{30}$ =+9.00(c 0.1, CH_3OH); FT-IR(KBr) cm^{-1}: 2945, 3038 (aromatic str.), 2870 (glucosidic-CH), 1612 (C=N), 1560(C=C), 1722 (C=O), 1078 (C-O-C); ^{1}H-NMR (400 MHz, DMSO-d_6) δ 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 $C_{32}H_{30}ClNO_{12}$ (656) C, 58.59; H, 4.61; N, 2.14 found C, 58.62; H, 4.62; N, 2.18.

4-(4-o-β-d-tetra-o-acetyl-glucoxybenzylidene)-2-(4-chloro styryl) oxazol-5-ones (3d)

Yield 72%; $[\alpha]_D^{30}$ =-14.12 (c 0.1, CH_3OH); FT-IR(KBr) cm^{-1}: 2905, 3011 (aromatic str.), 2878 (glucosidic-CH), 1620 (C=N), 1726 (C=O), 1080 (C-O-C); ^{1}H-NMR (400 MHz, DMSO-d_6) δ 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 $C_{32}H_{30}ClNO_{12}$ (656) C, 58.59; H, 4.61; N, 2.14 found C, 58.64; H, 4.63; N, 2.19.

4-(4-o-β-d-tetra-o-acetyl-glucoxybenzylidene)-2-(2-methoxy styryl) oxazol-5-ones (3e)

Yield 66%; $[\alpha]_D^{30}$=-21.44 (c 0.1, CH_3OH); FT-IR(KBr) cm^{-1}: 2912, 3035 (aromatic str.), 2855 (glucosidic-CH), 1614 (C=N), 1714 (C=O), 1091 (C-O-C); ^{1}H-NMR (400 MHz, DMSO-d_6) δ 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 $C_{32}H_{33}NO_{13}$ (651) C, 60.83; H, 5.10; N, 2.15 found C, 60.85; H, 5.10; N, 2.12.

4-(4-o-β-d-tetra-o-acetyl-glucoxybenzylidene)-2-(3-methoxy styryl) oxazol-5-ones (3f)

Yield 56%; $[\alpha]_D^{30}$=-20.11(c 0.1, CH_3OH); FT-IR(KBr) cm^{-1}: 2918,3035 (aromatic str.), 2858 (glucosidic-CH), 1518 (C=N),1610(C=C),1733(C=O), 1089 (C-O-C); ^{1}H-NMR (400 MHz, DMSO-d_6) δ 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 $C_{32}H_{33}NO_{13}$ (651) C, 60.83; H, 5.10; N, 2.15 found C, 60.83; H, 5.11; N, 2.11.

4-(4-o-β-d-tetra-o-acetyl-glucoxybenzylidene)-2-(4-methoxy styryl) oxazol-5-ones (3g)

Yield 66%; $[\alpha]_D^{30}$=-19.68 (c 0.1, CH_3OH); FT-IR(KBr) cm^{-1}: 2902,3030 (aromatic str.), 2852 (glucosidic-CH), 1612 (C=N),1646(C=C),1740(C=O), 1109 (C-O-C);

^{1}H-NMR (400 MHz, DMSO-d_6) δ 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 $C_{32}H_{33}NO_{13}$ (651) C, 60.83; H, 5.10; N, 2.15 found C, 60.80; H, 5.10; N, 2.19.

4-(4-o-β-d-tetra-o-acetyl-glucoxybenzylidene)-2-(3-nitro styryl) oxazol-5-ones (3h)

Yield 69%;$[\alpha]_D^{30}$=-14.25 (c 0.1, CH_3OH); FT-IR(KBr) cm^{-1}: 2912, 3108 (aromatic str.), 2871 (glucosidic-CH), 1615 (C=N), 1648(C=C),1710 (C=O), 1088 (C-O-C); ^{1}H-NMR (400 MHz, DMSO-d_6) δ 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 $C_{32}H_{30}N_2O_{14}$ (666) C, 57.66; H, 4.54; N, 4.20 found C, 57.68; H, 4.56; N, 4.22.

4-(4-o-β-d-tetra-o-acetyl-glucoxybenzylidene)-2-(4-dimethyamino styryl) oxazol-5-ones (3i)

Yield 62%;$[\alpha]_D^{30}$=-16.40 (c 0.1, CH_3OH); FT-IR(KBr) cm^{-1}: 2922,3034 (aromatic str.), 2880 (glucosidic-CH), 1627 (C=N),1635(C=C),1768 (C=O), 1079 (C-O-C); ^{1}H-NMR (400 MHz, DMSO-d_6) δ 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 $C_{34}H_{36}N_2O_{12}$ (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-β-d-glucoxybenzylidene)-2-(substituted styryl) oxazol-5-ones (4a-i)

The mixture of 4-(4-*O*-β-D-tetra-*O*-acetyl-glucoxybenzylidene)-2-styryl oxazol-5-ones (0.109 mmole), dry methanol (2 mL) and anhydrous zinc acetate (0.126 mmole) was refluxed for 7 h. After cooled down at room temperature, it was filtered through cation exchanged resin; the solvent was removed under vaccum. The residue was purified by silica gel chromatography ($CHCl_3$, MeOH, 12:1 v/v) to get title compound in brown semisolid form.

4-(4-o-β-d-glucoxybenzylidene)-2-styryl oxazol-5-ones (4a)

Yield 66%; $[\alpha]_D^{30}$=-14.11(c 0.1, DMSO); FT-IR(KBr) cm^{-1}: 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); ^{1}H-NMR (400 MHz, DMSO-d_6) δ 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); ^{13}C-NMR (100 MHz, DMSO-d_6) δ ppm : 138- 115 (Ar-C),sugar moiety: δ 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 (El,70ev): 453 (M) (15%), 290 (100%) base peak, 273 (18%), 188 (14%), 163 (6%), 80(13%). Anal. Calcd for $C_{24}H_{23}NO_8$ (453) C, 63.57; H, 5.11; N, 3.09 found C, 63.50; H, 5.10; N, 3.11.

4-(4-o-β-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^{-1}: 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); ^{1}H-NMR (400 MHz, DMSO-d_6) δ 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); ^{13}C-NMR (100 MHz, DMSO-d_6) δ ppm : 131.2-116.6 (Ar-C), sugar moiety: δ 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 (El, 70ev): 487 (M) (15%), 324 (15%), 180 (100%) base peak ,165 (15%), 163 (10%), 79 (31%). Anal. Calcd for $C_{24}H_{22}ClNO_8$ (487) C, 59.08; H, 4.55; N, 2.87 found C, 59.10; H, 4.58; N, 2.85.

4-(4-o-β-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^{-1}: 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); ^{1}H-NMR (400 MHz, DMSO-d_6) δ 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); ^{13}C-NMR (100 MHz, DMSO-d_6) δ ppm : 132.4-115 (Ar-C), sugar moiety: δ 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 (El, 70ev): 487 (M) (10%), 326 (11%), 181 (100%) base peak ,160 (18%), 163 (14%), 78 (30%). Anal. Calcd for $C_{24}H_{22}ClNO_8$ (487) C, 59.08; H, 4.55; N, 2.87 found C, 59.11; H, 4.52; N, 2.87.

4-(4-o-β-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^{-1}: 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); ^{1}H-NMR (400 MHz, DMSO-d_6) δ 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); ^{13}C-NMR (100 MHz, DMSO-d_6) δ ppm :, 132-117.2 (Ar-C), sugar moiety: δ 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 (El, 70ev): 487 (M) (18%), 322 (26%), 130 (100%) base peak ,168 (10%), 163 (14%), 77 (31%). Anal. Calcd for $C_{24}H_{22}ClNO_8$ (487) C, 59.08; H, 4.55; N, 2.87 found C, 59.05; H, 4.55; N, 2.83.

4-(4-o-β-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^{-1}: 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); ^{1}H-NMR (400 MHz, DMSO-d_6) δ 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) ; ^{13}C-NMR (100 MHz, DMSO-d_6) δ ppm : 107-130 (Ar-C), sugar moiety: δ 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 (El, 70ev): 483 (M) (11%),320 (15%), 215 (100%) base peak ,185 (28%), 130 (10%), 118 (24%). Anal. Calcd for $C_{25}H_{25}NO_9$ (483) C, 62.11; H, 5.21; N, 2.90 found C, 62.08; H, 5.24; N, 2.85.

4-(4-o-β-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^{-1}: 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); ^{1}H-NMR (400 MHz, DMSO-d_6) δ 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) ; ^{13}C-NMR (100 MHz, DMSO-d_6) δ ppm :107-128 (Ar-C), sugar moiety: δ 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 (El, 70ev): 483 (M) (20%), 320 (18%), ,175 (30%), 145 (100%) base peak, 130 (12%),116 (0.8%). Anal. Calcd for $C_{25}H_{25}NO_9$ (483) C, 62.11; H, 5.21; N, 2.90 found C, 62.14; H, 5.19; N, 2.86.

4-(4-o-β-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^{-1}: 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); ^{1}H-NMR (400 MHz, DMSO-d_6) δ 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); ^{13}C-NMR (100 MHz, DMSO-d_6) δ ppm :107-128 (Ar-C), sugar moiety: δ 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 (El, 70ev): 483 (M) (22%), 320 (15%), ,188 (21%), 165 (100%) base peak, 118 (12%), 77(20%). Anal. Calcd for $C_{25}H_{25}NO_9$ (483) C, 62.11; H, 5.21; N, 2.90 found C, 62.14; H, 5.19; N, 2.89.

4-(4-o-β-d-glucoxybenzylidene)-2-(3-nitro styryl) oxazol-5-ones (4h)

Yield 72%; $[\alpha]_D^{30}$=-15.10 (c 0.1, DMSO); FT-IR(KBr) 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}H-NMR (400 MHz, DMSO-d_6) δ 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}C-NMR (100 MHz, DMSO-d_6) δ ppm : 110-134 (Ar-C),sugar moiety: δ 103.0 (s, C-1') anomeric carbon, 78 (s,C-3'), 64 (s, C-2'); MS (El,70ev): 498 (M)

(15%), 336 (100%) base peak, 292 (13%), 190 (15%), 163 (8%), 78(11%). Anal. Calcd for $C_{24}H_{22}N_2O_{10}$ (498) C, 57.83; H, 4.45; N, 5.62 found C, 57.85; H, 4.48; N, 5.65.

4-(4 - o - β - d -glucoxybenzylidene) -2-(4-dimethyamino styryl) oxazol-5-ones (4i)

Yield 60%; $[\alpha]_D^{30}$=-18.65 (c 0.1, DMSO); FT-IR(KBr) 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}H-NMR (400 MHz, DMSO-d_6) δ 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}C-NMR (100 MHz, DMSO-d_6) δ ppm : 114-128 (Ar-C), sugar moiety: δ 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,70ev): 496 (M) (15%), 332 (16%), 270 (28%), 185 (100%) base peak, 163 (6%), 74 (10%). Anal. Calcd for $C_{26}H_{28}N_2O_8$ (496) C, 62.89; H, 5.68; N, 5.64 found C, 62.87; H, 5.60; N, 5.61.

TABLE 1: Biological activity 4 -(4-*O* -β-D-glucoxybenzylidene)-2-(substituted styryl) oxazol-5-ones

Zone of Inhibition[b] (mm) (Activity Index) [std]						
Entry	**Antibacterial Activity**				**Antifungal Activity**	
	Gram-positive		Gram-negative			
	S. aureus	*B. substilis*	*E. coli*	*K. aerogens*	*C. albicans*	*A. niger*
4a	29(0.85)* (0.93)#	28(0.96)* (1.07)#	24(0.68)* (0.82)#	18(0.81)* (0.85)#	16(0.76)* (0.69)#	24(0.96)* (1.00)#
4b	19(0.55)* (0.61)#	24(0.82)* (0.92)#	16(0.45)* (0.55)#	17(0.77)* (0.80)#	21(1.00)* (0.91)#	22(0.88)* (0.91)#
4c	23(0.67)* (0.74)#	15(0.51)* (0.57)#	23(0.65)* (0.79)#	19(0.86)* (0.90)#	22(1.04)* (0.95)#	21(0.84)* (0.87)#
4d	30(0.88)* (0.96)#	26(0.89)* (1.00)#	29(0.82)* (1.00)#	22(1.00)* (1.04)#	17(0.80)* (0.73)#	17(0.68)* (0.70)#
4e	12(0.35)* (0.38)#	15(0.51)* (0.57)#	18(0.51)* (0.62)#	20(0.90)* (1.95)#	11(0.52)* (0.47)#	21(0.84)* (0.87)#
4f	22(0.64)* (0.70)#	12(0.41)* (0.46)#	22(0.62)* (0.75)#	14(0.63)* (0.66)#	20(0.95)* (0.86)#	20(0.80)* (0.83)#
4g	12(0.35)* (0.38)#	14(0.48)* (0.53)#	12(034)* (0.41)#	16(0.72)* (0.76)#	18(0.85)* (0.78)#	21(0.84)* (0.87)#
4h	22(0.64)* (0.70)#	16(0.55)* (0.61)#	31(0.88)* (1.06)#	18(0.81)* (0.85)#	15(0.71)* (0.65)#	19(0.76)* (0.79)#
4i	14(0.41)* (0.45)#	18(0.62)* (0.69)#	21(0.60)* (0.72)#	12(0.54)* (0.57)#	16(0.76)* (0.69)#	15(0.60)* (0.62)#
Std.1	34	29	35	22	21	25
Std. 2	31	26	29	21	23	24

a= concentration of test compounds and standard 100 µg/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.

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