A Single Pot Synthesis of New Dimeric 2-Phenyl-10,3a–dihydro-1,3,4-oxadiazolino[3,2-*a*]quinazolin-6-ols

Anil Kumar, Summon Koul, T. K. Razdan* and C. S. Andotra

Department of Chemistry,
University of Jammu, Ambedkar Road, Jammu - 180006 (India)
E-mail : tk_razdan@rediffmail.com
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One pot synthesis of new unsymmetrical dimeric 2-phenyl-10,3a-dihydro-1,3,4-oxadiazolino[3,2-a]-quinazolin-6-ols from 2-amino-5-phenyloxadiazole and salicylaldehydes, in solid phase, using Hg (II)-Al_2O_3 catalyst, is described. The reaction is temperature sensitive, convenient, efficient and environmentally friendly.

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Transition metal mediated reactions have played a vital role in organic synthesis including synthesis of nitrogen heterocycles [1]. Coupled to this, there is a growing interest in solid state reactions, many of which are more efficient and selective than reactions in solution [2]. During the recent past, the versatility of clays and adsorbents to act as solid supports and simultaneously catalyse these reactions, sometimes regiospecifically and stereospecifically[3], has been well recognized. However, the drawback of these reactions is the involvement of large quantities of solid supports. This drawback could be overcome by altering adsorbent surfaces with catalytic amounts of metals or their ions so that their catalytic activity is synergized.

Our interest in developing new, cost–effective, convenient, and short methodologies for the synthesis of novel heteroaromatic compounds led us to envisage the synthesis of dimeric 2-phenyl-10,3a-dihydro-1,3,4-oxadiazolino[3,2-*a*]quinazolin-6-ols with an oxygen bridge (**2c** - **7c**) because compounds bearing such heterocyclic moieties have wide pharmacodynamic properties [4] including anti-microbial [5], antiedemic [6], antifungal [7] and anti-cancer [8,9] activity.

Substituted salicylaldehydes (**2** - **7**) were made to react, in solid phase, with 2-amino-5-phenyloxadiazole, prepared by well known method [10], in the presence of Hg(II)-Al_2O_3 catalyst at 110±5 °C. The reaction afforded unsymmetrical dimeric 2-phenyl-10,3a-dihydro-1,3,4-oxadiazolino[3,2-*a*]quinazolin-6-ols **2c**-**7c** (50-60%), with C-5, C-6 oxygen bridge between two quinazoline moieties, besides 2-amino(2-hydroxybenzylidene)-5-phenyl-1,3,4-oxadiazoles **2a**-**7a** (5-10%) and 2-phenyl-10,3a-dihydro-1,3,4-oxadiazolino[3,2-*a*]quinazolin-6-ols **2b**-**7b** (10-15%), (Table 1), which were characterized by spectral methods (IR, ^{1}H-NMR ^{13}C NMR and HREIMS). These observations led to the conclusion that the reaction proceeds through the initial formation of a Schiff's base, which underwent cyclisation *via* rearrangement of π bonds and hydrogen transfer, under the action of the catalyst, to the thermodynamically stable compounds **2b**-**7b**. The dimeric products **2c**-**7c** could possibly result from the, normally unexpected, addition of acidic phenol to the C=N bonds of the quinazoline moiety of **2b**-**7b** (Figure 1) in a fashion akin to the addition to the C=N bond of the benzophenanthridine alkaloid sanguinarine [11].

The novelty of this procedure is that the synthesis of dimeric compounds, which would require a series of

Scheme 1

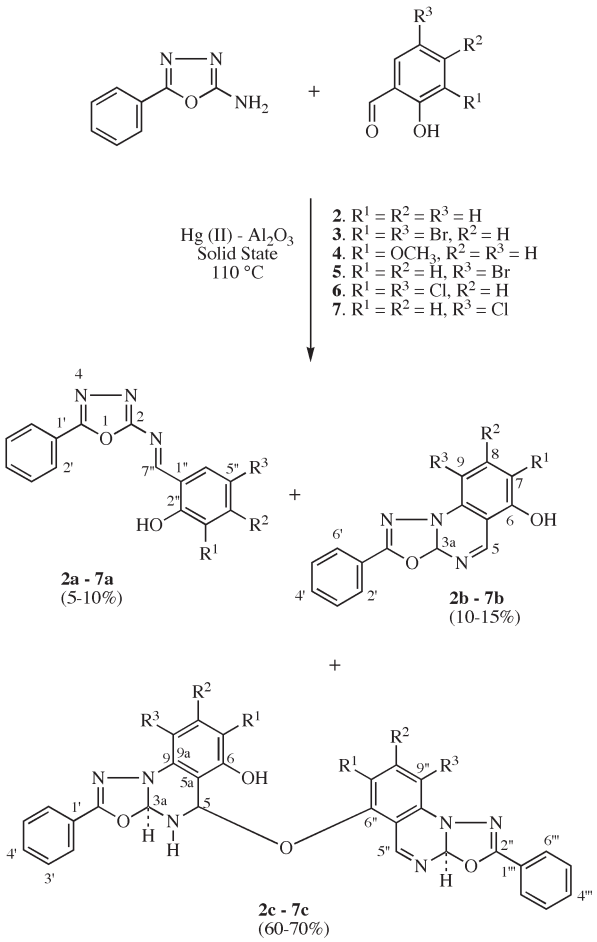

Table 1

Aldehydes	Percent Yield of Products **a**	**b**	**c**
2	7.5	12.2	60
3	5.0	15.5	65
4	6.5	10.5	70
5	10.0	11.5	68
6	7.0	11.0	69
7	7.0	10.0	67

stages, especially the cyclisation and dimerisation, is brought about in one stage.

The reaction failed to give dimeric product and also afforded an insignificant amount of cyclised product in solution. The use of microwave irradiations, neither improved the yield, nor did these alter the reaction pathway. The increase in the weight ratio of the catalyst to the substrate from 1.5:1 to 2.5:1 also caused only a marginal improvement in the percentage yield of the dimeric products. Further, the reaction was found to be thermosensitive with the optimum temperature being 110 ± 5 °C.

Hg(II) chloride doped alumina seems to be a better reagent than $ZnCl_2$… Al_2O_3 and $SnCl_2$ …. Al_2O_3, which failed to yield the desired dimeric product, but furnished a mixture of several undesirable products.

In conclusion, we have developed a new, one pot, convenient, efficient and environmentally friendly procedure for the synthesis of novel unsymmetrical dimeric 2-phenyl-10,3a-dihydro-1,3,4-oxadiazolino[3,2-*a*]quinazolin-6-ols. Although the present method seems to be a generalized method, it does not afford dimeric products in good yield (10-12%) when amino substituted salicylaldehydes are used as one of the substrates. The dimeric products are under scrutiny for antimicrobial and anticancer activity.

EXPERIMENTAL

Melting points were measured in open capillaries on Perfit melting point apparatus and are uncorrected. IR on KBr discs were taken on Brucker-4800 infrared spectrometer. ^{1}H-NMR (200 MHz) and ^{13}C-NMR (50.3 MHz), were recorded in $CDCl_3$ using a Brucker Ac DPX-200 spectrometer and HREIMS was recorded on JEOL D-300 mass spectrometer at 70 eV. TLC was performed on 0.5 mm thick plates, using BDH silicagel-G adsorbent. Column chromatography was performed on silica gel and compounds were eluted by graded solvent systems of petroleum ether (b.p. 40° – 60 °C) and benzene and were further crystallized from $CHCl_3$ – petroleum ether (b.p. 40° – 60 °C).

Preparation of Catalyst Hg (II) Chloride – Al_2O_3.

The catalyst was prepared by adsorbing Hg (II)- chloride (2.15 g), in ethanol (90%), for 48 hours, on chromatographic grade neutral alumina (10 g), air drying of the impregnated adsorbent, followed by heating, in a hot air oven, at 110° ± 5 °C for 30 minutes. The catalyst was reactivated each time before use by heating at this temperature for one hour.

Mechanism

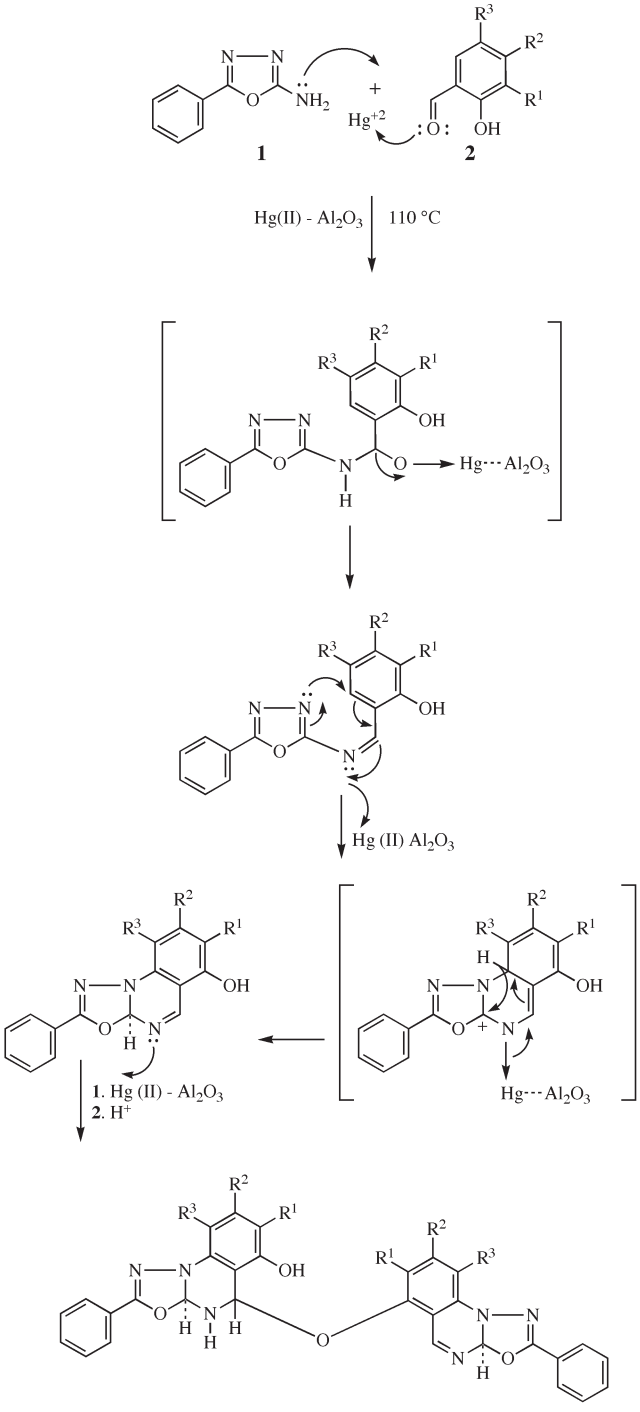

Figure 1

General Procedure for Synthesis of **2c**-**7c**.

2-Amino-5-phenyl-1,3,4-oxadiazole (**1**), substituted 2-hydroxybenzaldehydes (**2-7**), in 1:1 *M* ratio, were ground with appropriate quantity (1: 1.5 w/w) of the catalyst [Hg (II)-Al_2O_3] in a mortar-pestle. The mixture was charged into a stoppered flask and heated in a thermostatically controlled hot air oven maintained at 110 ± 5 °C. The reaction was monitored, by a separate experiment, by comparative T.L.C. After completion of the reaction (2.5 hr), the product mixtures were isolated with hot EtOAc; resolved by column chromatography on silica gel, using graded petroleum ether (40°-60 °C)-benzene solvent system, and purified by crystallisation from $CHCl_3$- petroleum ether. The products were analysed by spectral methods (IR, ^{1}H-NMR , ^{13}C –NMR and HREIMS).

2-Phenyl-5-(2-phenyl-10,3a-dihydro-1,3,4-oxadiazolino[3,2-*a*]-quinazolin-6-yloxy)-4,5,10,3a-tetrahydro-1,3,4-oxadiazilino-[3,2-*a*]quinazolin-6-ol (**2c**).

This compound was obtained as colourless crystals, m.p. 175 °C; IR: ν_{max} 3536, 3315, 3119, 1649, 1596,1490, 1300, 1043, 1024, 847, 790 cm^{-1}; ^{1}H-NMR: δ 6.97 (d, 2H, J = 7.5 Hz), 7.00 (d, 2H, J = 6.6Hz), 7.31 (s, 2H), 7.55 (m, 10H), 7.60 (s, 1H), 8.01 (dd, 2H, J = 7.5, 6.6Hz), 8.26 (br, s, N-H), 9.31 (s, 1H), 11.5 (s, 1H,-OH). HREIMS: m/z 530. 1648 (calcd. for $C_{30}H_{22}N_6O_4$, 530.1653), 282, 248, 222, 179,171, 170, 136, 117 (100 %), 94; ^{13}C-NMR: δ_C 110.8(C-5), 115.0(C-7''), 116.6(C-7), 117.6(C-2',2'''), 118.2(C-6',6'''), 121.0(C-9,9''), 126.8(C-4' , 4'''), 128.7(C-5', 5''', C-3', 3'''), 129.9 (C-8, 8'), 137.4 (C-5a, 5a''), 138.7(C-3a''), 139.4(C-1', 1'''), 143.5(C-3a), 150.1(C-10a), 154.2(C-6''), 155.9(C-2, 2''), 157.5 (C-5'').

Anal. Calcd. for $C_{30}H_{22}N_6O_4$: C, 67.9; H, 4.15; N, 15.8. Found: C, 67.3; H, 3.9; N, 16.32.

5-(7,9-Dibromo-2-phenyl-(10,3a-dihydro-1,3,4-oxadiazolino[3,2-*a*]quinazolin-6-yl)-oxy)-7,9-dibromo-2-phenyl-4,5,10,3a-tetrahydro-1,3,4-oxadiazilino[3,2-*a*]-quinazolin -6-ol (**3c**).

This compound was obtained as colourless needles, m.p. 195 °C; IR: ν_{max} 3178, 3033, 2953, 2920, 2848, 1653, 1604, 1546,1443, 1102, 880 cm^{-1}; ^{1}H-NMR : δ 7.35 (s, 2H), 7.51 (d, 6H, J = 6.65Hz), 7.56 (d, 4H, J = 6.65 Hz), 7.84 (s, 2H), 7.85 (s, 1H), 7.93 (s, 1H), 8.35 (br, s,1H), 10.55 (s, 1H, -OH); HREIMS: m/z 846.0606 (calcd. for $C_{30}H_{18}Br_4N_6O_4$, 846.0604), 440, 406, 378, 273, 168, 105, 90, 77 (100%), 51; ^{13}C-NMR: δ_C 105.9 (C-5), 116.0(C-7), 117.3(C-2', 2'''), 118.0(C-7''), 118.2(C-6, 6'''), 121.3(C-9), 123.3(C-9''), 126.8(C-4' , 4'''), 128.7(C-3', 3''', 5', 5'''), 129.9(C-8), 135.2(C-8''), 137.5(C-6, 6''), 139.4 (C-1' , 1'''), 143.5(C-3a), 147.9(C-3a''), 150.1(C-10a), 152.1 (C-10a''), 155.9(C-2, 2''), 156.8 (C-6, 6'') 157.7 (C-5'').

Anal. Calcd. for $C_{30}H_{18}Br_4N_6O_4$: C, 42.5; H, 2.1; N, 9.92. Found: C, 42.8; H, 2.4; N, 10.3.

7-Methoxy-5-(7-methoxy-2-phenyl(10,3a-dihydro-1,3,4-oxadiazolino[3,2-*a*]quinazolin-6yl)oxy)-2-phenyl-4,5,10,3a-tetrahydro-1,3,4-oxadiazilino[3,2-*a*]quinazolin-6-ol (**4c**).

This compound was obtained as colourless crystals, m.p.180 °C; IR: ν_{max} 3569, 3376, 3209, 3064, 2935, 2843, 1776, 1716, 1653, 1606, 1365, 1074, 965, 887cm^{-1}; ^{1}H-NMR: δ 3.93 (s, 6H), 6.93 (m, 6H), 7.28(m, 7H), 7.53 (d, 2H, J = 7.0Hz), 7.90 (d, 2H, J = 7.4 Hz), 8.60 (s, 1H), 9.30 (br, s, 1H, -NH), 10.9 (s, br., 1H, -OH); HREIMS: m/z 590.1908 (M^+)(calcd. for $C_{32}H_{26}N_6O_6$ 590.1906), 563, 575, 547, 201, 131, 77, 51; ^{13}C-NMR: δ_C 55.8 (2 x OCH_3), 107.46 (C-5), 114.1 (C-8, 8''), 117.6 (C-2', 2'''), 118.2 (C-6', 6'''), 126.8 (C-4', 4'''), 128.7 (C-3', 5', 3''', 5'''), 129.6 (C-9, 9''), 136.6 (C-5a, 5a''), 139.3 (C-1', 1'''), 142.2 (C-6, 6''), 142.9 (C-3a), 147.5 (C-7, 7''), 148.9 (C-3a''), 149.2 (C-10a, 10a''), 155.9 (C-2, 2''), 157.7 (C-5'').

Anal. Calcd. for $C_{32}H_{26}N_6O_2$: C, 65.08; H, 4.40; N, 14.2. Found: C, 65.08; H, 4.40; N, 14.2.

9-Bromo-5-(9-bromo-2-phenyl(10,3a-dihydro-1,3,4-oxadiazolino[3,2-*a*]quinazolin-6-yl)oxy)-2-phenyl-4,5,10,3a-tetrahydro-1,3,4-oxadiazilino[3,2-*a*]quinazolin-6-ol (**5c**).

This compound was obtained as colourless crystals, m.p. 187 °C; IR: ν_{max} 3450, 3185, 3035, 2950, 2915, 2840, 1650, 1605, 1545, 1435, 1101, 880 cm^{-1}; ^{1}H-NMR: δ 6.99 (d, 2H, J= 8.5 Hz), 7.00 (d, 2H, J = 8.6Hz), 7.34 (s, 2H), 7.50 (d, 6H, J = 6.4 Hz), 7.56 (d, 4H, J = 6.5Hz), 7.85 (s, 2H), 7.92 (s, 1H), 10.56 (s, 1H, -OH); HREIMS: m/z 688.1542 (calcd. for $C_{30}H_{20}Br_2N_6O_4$, 688.1548), 361, 327, 301, 171, 105(100%), 77, 67, 51; ^{13}C-NMR: δ_C 107.3 (C-5), 114.1(C-7, 7''), 117.5(C-2', 2'''), 118.2(C-6', 6'''), 120.1(C-9, 9''), 126.8(C-4', 4'''), 128.7 (C-3', 5', 3''', 5'''), 133.6(C-8, 8''), 137.5(C-5a, 5a''), 139.4(C-1', 1'''), 148.5 (C-3a''), 149.7 (C-3a), 150.3 (C-10a, 10a''), 153.3 (C-6, 6''), 157.5 (C-5'').

Anal. Calcd. for $C_{30}H_{20}Br_2N_6O_4$: C, 53.0; H, 2.9; N, 12.2. Found: C, 52.7; H, 3.1; N, 1.29.

7,9-Dichloro-5-(7,9-dichloro-2-phenyl(10,3a-dihydro-1,3,4-oxadiazolino[3,2-*a*]quinazolin-6-yl)oxy)-2-phenyl-4,5,10,3a-tetrahydro-1,3,4-oxadiazilino[3,2-*a*]quinazolin-6-ol (**6c**).

This compound was obtained as colourless needles, m.p. 185 °C; IR: ν_{max} 3508,1175, 3033, 2950, 2920, 2845, 1650, 1604, 1546, 1440, 1100, 880 cm^{-1}; ^{1}H-NMR: δ 7.29(s, 2H), 7.45(d, 6H, J=6.65Hz), 7.50 (d, 4H, J=6.65 Hz), 7.79 (s, 2H), 7.85 (s, 1H), 7.93 (s, 1H), 8.30 (br, s, 1H), 10.46 (br, s, 1H- OH); ^{13}C-NMR: δ_C 106.6 (C-5), 117.9 (C-2', 2'''), 118.2 (C-6', 6'''), 122.9(C-9, 9''), 126.8(C-4', 4'''), 128.7(C-3', 5', 3'', 5''), 129.3 (C-8, 8''), 134.5 (C-7, 7''), 137.8(C-5a, 5a''), 139.4(C-1', 1'''), 148.5(C-3a, 3a''), 152.3(C-10a, 10a''), 155.7(C-2, 2''), 155.9(C-6, 6''), 158.9 (C-5''); HREIMS: m/z 666. 1386 (calcd. for $C_{30}H_{18}Cl_4N_6O_4$, 668.012), 350, 322, 316, 262, 256, 286, 171, 105, 77, 76 (100%), 60, 51; CHN analysis was not obtained.

9-Chloro-5-(9-chloro-2-phenyl(10, 3a-dihydro-1,3,4-oxadiazolino[3,2-*a*]quinazolin-6-yl)oxy)-2-phenyl-4,5,10,3a-tetrahydro-1,3,4-oxadiazilino[3,2-*a*]quinazolin-6-ol (**7c**).

This compound was obtained as colourless crystals, m.p. 190 °C; IR: ν_{max} 3515, 3189, 3040, 2950, 2921, 2845, 1640, 1600, 1545, 1430, 999, 880 cm^{-1}; ^{1}H-NMR: δ 6.98 (d, 2H, J = 8.8Hz), 7.01 (d, 2H, J = 8.6Hz), 7.31 (s, 2H), 7.53 (t, 6H, J =6.6Hz), 7.54 (t, 4H, J = 6.5Hz), 7.85 (s, 1H), 7.89 (s, 1H), 8.09 (s, br, 1H, -NH), 10.95 (s, 1H, -OH); HREIMS: m/z 598.1542 (calcd. for $C_{30}H_{20}Cl_2N_6O_4$, 598.1547), 316, 288, 282, 256, 228, 186, 170, 105, 77 (100%), 60, 51; ^{13}C-NMR ($CDCl_3$): δ_C 107.2 (C-5), 116.7 (C-7, 7''), 117.9 (C-2', 2'''), 118.6 (C-6', 6'''),126.7 (C-4' , 4'''), 128.8 (C-3' , 5' 3''', 5'''), 130.1 (C-8, 8''), 134.8 (C-9, 9''), 137.9 (C-5a, 5a''), 139.4 (C-1' , 1'''), 148.5 (C-3a, 3a''), 152.1 (C-10a, 10a''), 154.5 (C-6, 6''), 155.7 (C-2, 2''), 157.8 (C-5'').

Anal. Calcd. for $C_{30}H_{20}Cl_2N_6O_4$: C, 60.2; H, 3.3; N, 14.04. Found: C, 59.1; H, 3.7; N, 14.5.

2-Amino(2-hydroxybenzylidene)-5-phenyl-1,3,4-oxadiazole,(**2a**).

This compound was obtained as yellowish crystals, m.p. 90 °C; IR: ν_{max} 3548, 2922, 1625, 1602, 1563, 1339, 1275, 1095, 1021, 825cm^{-1}; ^{1}H-NMR: δ 6.94 (d, 1H, J = 7.5Hz), 7.00 (d, 1H,

J = 6.5 Hz), 7.39 (m, 2H),7.51 (m, 5H), 9.30 (s, 1H), 11.5 (s, 1H, -OH); HREIMS: m/z 265.7860 (calcd. for $C_{15}H_{11}N_3O_2$, 265. 7865), 145, 105, 93, 77 (100%), 65, 51.

Anal. Calcd. for $C_{15}H_{11}N_3O_2$: C, 67.9; H, 4.1; N, 15.8. Found: C, 66.9; H, 4.9; N, 16.5.

2-Amino(3,5-dibromo-2-hydroxybenzylidene)-5-phenyl-oxadiazole (**3a**).

This compound was obtained as yellowish crystals, m.p. 105 °C; IR: ν_{max} 3439, 3178, 3033, 2953, 2920, 2848, 1653, 1604, 1546, 1443, 1102, 885 cm^{-1}; ^{1}H-NMR: δ 7.57 (t, 4H, J = 8.8 Hz), 7.60 (t, 1H, J = 8.5 Hz), 7.83 (d, 2H, J= 1.7 Hz), 8.55 (s, 1H), 12.57 (s, 1H, -OH); HREIMS: m/z 423.0693 (calcd. for $C_{15}H_9Br_2N_3O_2$, 423.0689), 251, 145, 105, 94, 77(100%), 51; CHN analysis was not obtained.

2-Amino(2-hydroxy-3-methoxybenzylidene)-5-phenyl-1,3,4-oxadiazole (**4a**).

This compound was obtained as yellowish crystals, m.p. 112 °C; IR: ν_{max} 3443, 3019, 2935, 1771, 1599, 1577, 1527, 1461, 1242, 1074, 1023, 965, 843 cm^{-1}; ^{1}H-NMR: δ 3.93 (s, 3H), 6.96 (t, 1H, J = 7.6Hz), 7.15 (t, 2H, J= 8.7 Hz), 7.56 (d, 3H, J = 4.7Hz), 8.08 (t, 2H, J = 3.5 Hz), 9.33 (s, 1H); 11.88(s, 1H, OH); HREIMS: m/z 295. 0954 (calcd. for $C_{16}H_{13}N_3O_3$, 295.0958), 267, 123, 105, 77(100%), 51. CHN analysis was not obtained.

2-Amino(5-bromo-2-hydroxybenzylidene)-5-phenyl-1,3,4-oxadiazole (**5a**).

This compound was obtained as yellowish crystals, m.p. 110 °C; IR: ν_{max} 3501, 3169, 3025, 2955, 2915, 2845, 1650, 1610, 1545, 1440, 1105, 880 cm^{-1}; ^{1}H-NMR: δ 6.99 (t like, 1H, J = 6.9 Hz), 7.18 (t, 2H, J = 8.7 Hz), 7.55 (t, 4H, J = 8.5Hz), 7.62 (t, 1H, J = 8.5Hz), 8.60 (s, 1H), 12.55 (br, s, 1H, OH); HREIMS: m/z 344.0771 (calcd. for $C_{15}H_{10}N_3O_2$ Br, 344.0775), 172, 145, 105, 77 (100%), 67, 51. CHN analysis was not obtained.

2-Amino(3,5-dichloro-2-hydroxybenzylidene)-5-phenyl-1,3,4-oxadiazole (**6a**).

This compound was obtained as yellowish crystals, m.p. 115 °C; IR ν_{max} 3439, 3170, 3030, 2950, 2910, 2845, 1650, 1604, 1546, 1440, 1102, 885 cm^{-1}; ^{1}H-NMR: δ 7.56 (t, 4H, J = 8.8Hz), 7.50 (t, 1H, J = 8.5 Hz), 7.71 (d, 2H, J = 1.7Hz), 8.45 (s, 1H) 12.57 (s, 1H, OH); HREIMS: m/z 333. 0693 (calcd. for $C_{15}H_9Cl_2N_3O_2$, 333.0697), 161, 145, 133, 105, 77 (100%), 60, 51. CHN analysis was not obtained.

2-Amino(5-chloro-2-hydroxybenzylidene)-5-phenyl-1,3,4-oxadiazole (**7a**).

This compound was obtained as yellowish crystals, m.p. 120 °C; IR: ν_{max} 3500, 3180, 3026, 2950, 2920, 2845, 1653, 1600, 1550, 1435, 1100, 885 cm^{-1}; ^{1}H-NMR: δ 6.98 (t, 1H, J = 6.6 Hz), 7.05 (t, 2H, J = 6.6Hz), 7.59 (t, 4H, J = 8.5Hz), 7.70 (t, 1H, J = 8.5 HZ), 8.71 (s, 1H), 12.50 (br, s, 1H, -OH); HREIMS: m/z 299.0771 (calcd. for $C_{15}H_{10}ClN_3O_2$, 299.0775), 145, 127, 105, 77 (100%), 67, 51; CHN analysis was not obtained.

2-Phenyl-10,3a-dihydro-1,3,4-oxadiazolino[3,2-*a*]quinazolin-6-ol (**2b**).

This compound was obtained as creamish crystals, m.p. 140 °C; IR: ν_{max} 3548, 2922, 1623, 1600, 1565, 1339, 1279, 1092, 1024, 822 cm^{-1}; ^{1}H-NMR: δ 6.99 (d, 1H, J = 7.4Hz), 7.03 (d, 1H, J = 6.5Hz), 7.36 (s, 1H), 7.54 (m, 5H), 8.08 (dd, 1H, J = 7.4, 6.5Hz), 9.34 (s, 1H), 11.8 (s, 1H, -OH); HREIMS: m/z 265.7860 (calcd. for $C_{15}H_{11}N_3O_2$, 265.7865), 264, 238, 210, 119, 105, 102, 90, 77(100%), 51; ^{13}C-NMR : δ_C 115.0 (C-7), 117.6 (C-2'), 118.2 (C-6'), 126.8 (C-4'), 127.5 (C-9), 128.7 (C-3', C-5'), 129.9 (C-8), 137.4 (C-5a), 139.4 (C-1), 147.9 (C-3a), 150.1 (C-10a), 154.2 (C-6),157.2 (C-5), 155.9 (C-2).

Anal. Calcd. for $C_{15}H_{11}N_3O_2$: C, 67.9; H, 4.15; N, 15.84. Found: C, 67.4; H, 3.9; N, 14.9.

7,9-Dibromo-2-phenyl-10,3a-dihydro-1,3,4-oxadiazolino[3,2-*a*]-quinazolin-6-ol (**3b**).

This compound was obtained as colourless crystals, m.p. 144 °C; IR: ν_{max} 3440, 3180, 3032, 2953, 2920, 2845, 1650, 1600, 1545, 1440, 1101, 890 cm^{-1}; ^{1}H-NMR: δ 7.30 (s, 1H), 7.53 (d, 3H, J = 6.6 Hz), 7.56 (d, 2H, J = 6.6 Hz), 7.85 (s, 1H), 7.95 (s, 1H), 10.52 (s, 1H, -OH); HREIMS: m/z 423. 0693 (calcd. for $C_{15}H_9Br_2N_3O_2$, 423.0698), 396, 278, 145, 105, 90, 77(100%), 51; ^{13}C-NMR: δ_C 117.5 (C-2'), 118.0 (C-7), 118.2 (C-6'), 123.3 (C-9), 126.8 (C-4'), 128.7 (C-3', C-5'), 135.2 (C-8), 137.5 (C-5a), 139.4 (C-1'), 147.9 (C-3a), 152.1 (C-10a), 155.9 (C-2), 156.8 (C-6), 157.7 (C-5). CHN analysis was not obtained.

7-Methoxy-2-phenyl-10,3a-dihydro-1,3,4-oxadiazolino[3,2-*a*]-quinazolin-6-ol (**4b**).

This compound was obtained as creamish crystals, m.p. 152 °C; IR: ν_{max} 3561, 3061, 2928, 2841, 1776, 1716, 1695, 1619, 1580, 1530, 1487, 1073, 882 cm^{-1}; ^{1}H-NMR: δ 3.90 (s, 3H), 6.86 (d, 1H, J = 7.4Hz), 7.15 (d, 1H, J = 7.3Hz), 7.42 (s, 1H), 7.53(m, 5H), 7.96(s, 1H), 8.17 (s, 1H, -OH); HREIMS: m/z 295.0941 (calcd. for $C_{16}H_{13}N_3O_3$, 295.0959), 281, 218, 149, 146, 123, 105, 90, 77 (%); ^{13}C-NMR: δ_C 55.3 (OCH_3), 114.1 (C-8), 117.6 (C-2'), 118.2 (C-6'), 126.8 (C-4'), 128.7 (C-3', C-5'), 129.6 (C-9), 136.6 (C-5a), 139.3 (C-1'), 142.9 (C-6), 147.5 (C-7), 147.8 (C-3a), 149.2 (C-10a), 155.9 (C-2), 157.7 (C-5).

Anal. Calcd. for $C_{16}H_{13}O_3N_3$: C, 65.08; H, 4.40; N, 14.23. Found: C, 64.8; H, 4.2; N, 14.0.

9-Bromo-2-phenyl-10,3a-dihydro-1,3,4-oxadiazolino[3,2-*a*]-quinazolin-6-ol (**5b**).

This compound was obtained as creamish crystals, m.p. 147 °C; IR: ν_{max} 3441, 3185, 3035, 2951, 2915, 2840, 1650, 1600, 1541, 1433, 1100, 880 cm^{-1}; ^{1}H-NMR: δ 6.98 (d, 1H, J = 8.6Hz), 7.02 (d,1H, J = 8.5Hz), 7.35 (s, 1H), 7.51 (t, 3H, J = 6.5 Hz), 10.55 (s, 1H, -OH); HREIMS: m/z 344.0771 (calcd. for $C_{15}H_{10}BrN_3O_2$, 344. 0775), 317, 316, 288, 145, 105, 77(100%), 51; ^{13}C-NMR: δ_C 114.7 (C-7), 117.5 (C-2'), 118.2 (C-6'), 120.1 (C-9), 126.8 (C-4'), 128.7 (C-3' , C-5'), 133.6 (C-8), 137.5 (C-5a), 139.4 (C-1'), 148.5 (C-3a), 152.3 (C-10a), 153.8 (C-6), 155.9 (C-2), 157.6 (C-5).

Anal. Calcd. for $C_{15}H_{10}BrN_3O_2$: C, 73.7; H, 4.09; N, 17.20. Found C, 73.4; H, 3.8; N, 16.9.

7,9-Dichloro-2-phenyl-10,3a-dihydro-1,3,4-oxadiazolino[3,2-*a*]-quinazolin-6-ol (**6b**).

This compound was obtained as colourless crystals m.p.143 °C; IR: ν_{max} 3430, 3180, 3030, 2950, 2840, 1650, 1600, 1545, 1440, 1110 890 cm^{-1}; ^{1}H-NMR: δ 7.30 (s, 1H), 7.50 (d, 3H, J = 6.6Hz) 7.56 (d, 2H, J = 6.6Hz), 7.85 (s, 1H), 7.88 (s, 1H), 10.40(s, 1H, OH); HREIMS: m/z 333.0693 (calcd. for $C_{15}H_9Cl_2N_3O_2$, 333. 0699), 306, 246, 230, 170, 105, 77, 76, (100%),51; ^{13}C-NMR: δ_C 117.9 (C-2'), 118.2 (C-6'), 122.3 (C-9), 126.8 (C-4'), 128.7 (C-3' , C-5') , 129.3 (C-8), 134.5 (C-7), 137.9

(C-5a), 139.4 (C-1'), 148.5 (C-3a), 152.3 (C-10a), 155.7 (C-2), 155.9 (C-6), 157.8 (C-5). CHN analysis was not obtained.

9-Chloro-2-phenyl-10,3a-dihydro-1,3,4-oxadiazolino[3,2-*a*]-quinazolin-6-ol(**7b**).

This compound was obtained as colourless crystals, m.p. 150°C; IR: ν_{max} 3500, 3205, 3031, 2945, 2920, 2841, 1600, 1540, 1432, 995, 880 cm^{-1}; ^{1}H-NMR: δ 6.99 (d, 1H, J = 8.5Hz), 7.05 (d, 1H, J = 8.5 Hz), 7.32 (s, 1H), 7.50 (t, 3H, J = 6.5 Hz), 7.54 (t, 2H, J = 6.6Hz), 7.89 (s, 1H), 11.0 (s, 1H, -OH); HREIMS: m/z 299.0771 (calcd. for $C_{15}H_{10}ClN_3O_2$, 299.0768), 272, 212, 170, 105, 77(100%), 60, 51; ^{13}C NMR: δ_C 116.7 (C-7), 117.9 (C-2'), 118.3 (C-6'), 126.7 (C-4'), 128.8(C-3' , C-5'), 130.1 (C-8), 134.8 (C-9), 137.7 (C-5a), 139.4 (C-1'), 148.5 (C-3a), 152.1 (C-10a), 154.5 (C-6), 155.7 (C-2), 157.8 (C-5). CHN analysis was not obtained.

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