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Synthesis and antibacterial activity of oxazaphospholan-2-ones/ thiones/ selenones

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ABSTRACT

*A new series of 5-[2-(9h-4-carbazolyl)ethyl]-3-isopropyl-2-phenoxy-1,3,2λ^5- oxazaphospholan-2-ones/ thiones/ selones (**5a-j**) were prepared by reacting 1-(9H-carbazol-4-yloxy)-3-(isopropylamino)propan-2-ol (**1**) with dichlorophenyl phosphine **(2a)** and phosphorodichloridates (**4d-j**) in toluene in the presence of triethylamine under N_2 atmosphere. All the title compounds were evaluated for antimicrobial activity to determine their efficacy and were effective in suppressing the growth of bacteria. The compounds show significant to high anti bacterial activity when compared with other Oxazaphospholan-2-ones/ thiones/ selenones. The chemical structures of the title products were characterized by IR, ^1H, ^{13}C, ^{31}P-NMR, mass spectral studies and elemental analysis.*

Keywords: Oxazaphospholan-2-ones / thiones / selenones, antibacterial activity.

INTRODUCTION

Organophosphorus heterocyclic (OPH) moiety is an important structural component in agricultural and pharmaceutical compounds[1]. OPH derivatives form a significant class of antibiotics, herbicides and antiviral agents[2]. Discovery of their fungicidal properties is a recent development[3]. Compounds with oxazaphospholidine moiety are an effective, broad-spectrum insecticides and fungicides[4,5]. These compounds have also been applied successfully in enantioselective catalysis[6] and asymmetric synthesis[7].

EXPERIMENTAL SECTION

Synthesis of 5-[(9*H*-4-carbazolyloxy)methyl]-3-isopropyl-2-phenyl-1,2λ^5-oxazaphospholan-2-one (5a): 1-(9*H*-carbazol-4-yloxy)-3-(isopropylamino)propan-2-ol (0.001 mole) (**1**) dissolved in 30 mL of dry toluene was taken in a three - necked flask. Triethyl amine (0.002 mole) in 10 mL of toluene was added to it. Dichlorophenyl phosphine **(2a)** (0.001 mole) in 15 mL of toluene was added dropwise to the strring reaction mixture at 0-10 ºC under N_2 atmosphere. After completion of the addition, the reaction mixture temperature was slowly raised to 35 ^{0}C and continued stirring for 2 hrs. Completion of the reaction was monitored by TLC by using silica plates as an adsorbent and ethyl acetate-hexane mixture (7:3) as mobile phase. After completion of the reaction, the reaction mixture was allowed to settle for 15 min and separated the precipitated $Et_3N.HCl$ salt by filtration. The filtrate contains trivalent phosphorus intermediate **3a.** To the intermediate **3a,** 5 mL of H_2O_2 was further added at 0-5 ^{0}C. the reaction mixture temperature was raised to reflux temp. and maintained at reflux for 2 hrs with stirring. After completion of the reaction as indicated by TLC, then the mixture was filtered and solvent was removed in a rotaevaporator. The residue containing oxazaphospholidine derivative (**5a**) was purified by column chromatography using neutral silica gel as an adsorbent and ethyl acetate-hexane (ratio 3:7) as an eluent. Finally it was recrystallized from ethanol to obtain analytically pure compound.

yield: 68%; mp: 155-157 ^{0}C. ir (potassium bromide): 3391, 1460, 1265 cm^{-1}; ^{1}H nmr (deuteriochloromethane): δ 9.93 (1H, s, Ar-NH), 8.29-6.69 (12H, m, Ar-H), 4.37-4.30 (2H, t, *J* = 7.2 Hz, OCH_2), 4.18 (1H, m, CH), 3.88-3.69 (3H, m, NCH_2, NCH), 1.37 (3H, d, *J* = 7.2 Hz, CH_3), 1.28 (3H, d, *J* = 7.3 Hz, CH_3); ^{13}C nmr (deuteriochloromethane): δ 101.8 (C-1), 125.3 (C-2), 117.4 (C-3), 149.9 (C-4), 149.7 (C-4a), 105.8 (C-4b), 120.9 (C-5), 124.7 (C-6), 125.6 (C-7), 112.5 (C-8), 126.9 (C-8a), 138.8 (C-9a), 137.7 (C-1"), 129.8 (C-2" & C-6"), 132.8 (C-3"& C-5"), 134.6 (C-4"), 68.7 (C-6', OCH_2), 70.4 (C-5', CH), 46.6 (C-4', CH_2), 45.8 (C-7' NCH), 24.6 (C-1'" & 2'"CH_3); ^{31}P nmr (dimethyl sulfoxide): δ 24.70; lcms: m/z 421 $(M+1)^+$. *Anal.* Calcd. for $C_{24}H_{25}N_2O_3P$: C, 68.56; H, 5.99. Found: C, 68.45; H, 6.15.

Compounds **5b** and **5c** were prepared following this procedure by reacting **3a** with S and Se respectively.

5-[(9*H*-4-Carbazolyloxy)methyl]-3-isopropyl-2-phenyl-1,2λ^5-oxazaphospholan-2-thione (5b) yield: 69%; mp: 225-227 ^{0}C; ir (potassium bromide): 3399, 1478, 790 cm^{-1}; 1H nmr (deuteriochloromethane): δ 9.99 (1H, s, Ar-NH), 8.39-6.72 (12H, m, Ar-H), 4.97-4.90 (2H, t, *J* = 7.2 Hz, OCH_2), 4.58 (1H, m, CH), 4.18-3.78 (3H, m, NCH_2, NCH), 1.47 (3H, d, *J* = 7.2 Hz, CH_3), 1.38 (3H, d, *J* = 7.3 Hz, CH_3); ^{13}C nmr (deuteriochloromethane): δ 102.3 (C-1), 125.0 (C-2), 117.4 (C-3), 149.7 (C-4), 146.2 (C-4a), 105.3 (C- 4b), 119.8 (C-5), 122.4 (C-6), 120.7 (C-7), 113.5 (C-8), 126.4 (C-8a), 138.9 (C-9a), 130.3 (C-1"), 134.5 (C-2"& C-6"), 127.6 (C-3"& C-5"), 136.8 (C-4"), 69.8 (C-6', OCH_2), 75.7 (C-5', CH), 45.6 (C-4', CH_2), 43.9 (C-7', NCH), 24.6 (C-1'" & 2'"CH_3); ^{31}P nmr (dimethyl sulfoxide): δ 36.20; lcms: m/z 437 (17), $(M+1)^+$and 251 (100). *Anal.* Calcd. for: $C_{24}H_{25}N_2O_2PS$. C, 68.94; H, 6.02; Found C, 68.62; H: 6.16.

.5-[(9*H*-4-Carbazolyloxy)methyl]-3-isopropyl-2-phenyl-1,2λ^5-oxazaphospholan-2-selone(5c) yield: 61%; mp: 258-260 ^{0}C; ir (potassium bromide): 3398, 1480, 688 cm^{-1}; ^{1}H nmr (deuteriochloromethane): δ 9.97 (1H, s, Ar-NH), 8.31-6.65 (12H, m, Ar-H), 4.97-4.90 (2H, t, *J* = 7.3 Hz, OCH_2), 4.58 (1H, m, CH), 4.18-3.78(3H, m, NCH_2, NCH), 1.47 (3H, d, *J* = 7.2 Hz, CH_3); 1.39 (3H, d, *J* = 7.3 Hz, CH_3); ^{13}C nmr (deuteriochloromethane): δ102.6 (C-1), 125.0 (C-2), 117.5 (C-3), 149.2 (C-4), 146.7 (C-4a), 105.4 (C- 4b), 119.7 (C-5), 122.4 (C-6), 120.7 (C-7),

113.5 (C-8), 126.4 (C-8a), 138.9 (C-9a), 134.5 (C-1"), 134.5 (C-2"& C-6"), 127.6 (C-3"& C-5"), 136.8 (C-4"), 69.8 (C-6', OCH_2), 75.7 (C-5', CH), 45.9 (C-4', CH_2), 43.4(C-7', NCH), 24.6 (C-1'" & 2'"CH_3); ^{31}P nmr (dimethyl sulfoxide): δ 72.81; lcms: m/z 485 (25), $(M+1)^+$and 421(100). *Anal.* Calcd. for $C_{24}H_{25}N_2O_2PSe$. C, 62.24; H, 5.43; Found C, 61.99; H, 5.36.

Synthesis of 5-[(9*H*-4-Carbazolyloxy)methyl]-3-isopropyl-2-phenoxy-1,2 λ^5-oxazaphospho - lan-2-one (5d):

1-(9*H*-Carbazol-4-yloxy)-3-(isopropylamino)propan-2-ol (0.001 mole) (**1**) dissolved in 30 mL of dry toluene in a three - necked flask. Triethyl amine (0.002 mole) in 10 mL of toluene was added to it. Phenylphosphorodichloridate **(4d)** (0.001 mole) in 10 mL of toluene was added dropwise to this reaction mixture kept stirring at 0-10 ºC under N_2 atmosphere. After completion of the addition, the reaction temperature was slowly raised to 50 ºC temperature continued stirring for 1.5 h. Completion of the reaction was monitored by TLC using silica plates as an adsorbent and ethyl acetate-hexane mixture (7:3) as mobile phase. After completion of the reaction, the reaction mixture was allowed to settle for 15 min and the separated $Et_3N.HCl$ salt was removed by filtration. The solvent from the filtrate was removed in a rotaevaporator. The residue containing the crude oxazaphospholan derivative (**5d**) was purified by column chromatography using neutral silica as an adsorbent and ethyl acetate- hexane (3:7) as an eluent. Finally it was recrystallized from ethanol to obtain analytically pure compound.

Yield: 75%; mp: 178-181 ºC; ir (potassium bromide): 3391, 1266, 1110, 911 cm^{-1}; ^{1}H nmr (deuteriochloromethane): δ 10.00 (1H, s, Ar-NH), 7.90-6.20 (12H, m, Ar-H); 4.56-3.3 (3H, m, OCH_2, OCH), 3.18-2.30 (3H, m, NCH_2, NCH), 1.5 (3H, d, *J* = 7.2 Hz, CH_3), 1.00 (3H, d, *J* = 7.2 Hz, CH_3); ^{13}C nmr (deuteriochloromethane): δ 104.0 (C-1), 132.0 (C-2), 107.6 (C-3), 141.3 (C-4), 131.3 (C-4a), 119.5 (C-4b), 114.0 (C-5), 104.3 (C-6), 110.1 (C-7), 116. 8 (C-8), 138.8 (C-8a), 122.7 (C-9a), 151.3 (C-1"), 125. 0 (C-2"& C-6"), 126.8 (C-3"& C-5"), 122.5 (C-4"), 71.1 (C-5', OCH), 69.5 (C-6', OCH_2), 51.3 (C-7', CH), 46.3 (C-4', NCH_2), 22.6 (C-1'" & 2'", CH_3); ^{31}P nmr (dimethyl sulfoxide): δ 22.70; lcms: m/z 437 (100), $(M+1)^+$. *Anal.* Calcd. for $C_{24}H_{25}N_2O_4P$. C, 66.05; H, 5.77; Found C, 65.82; H: 5.56.

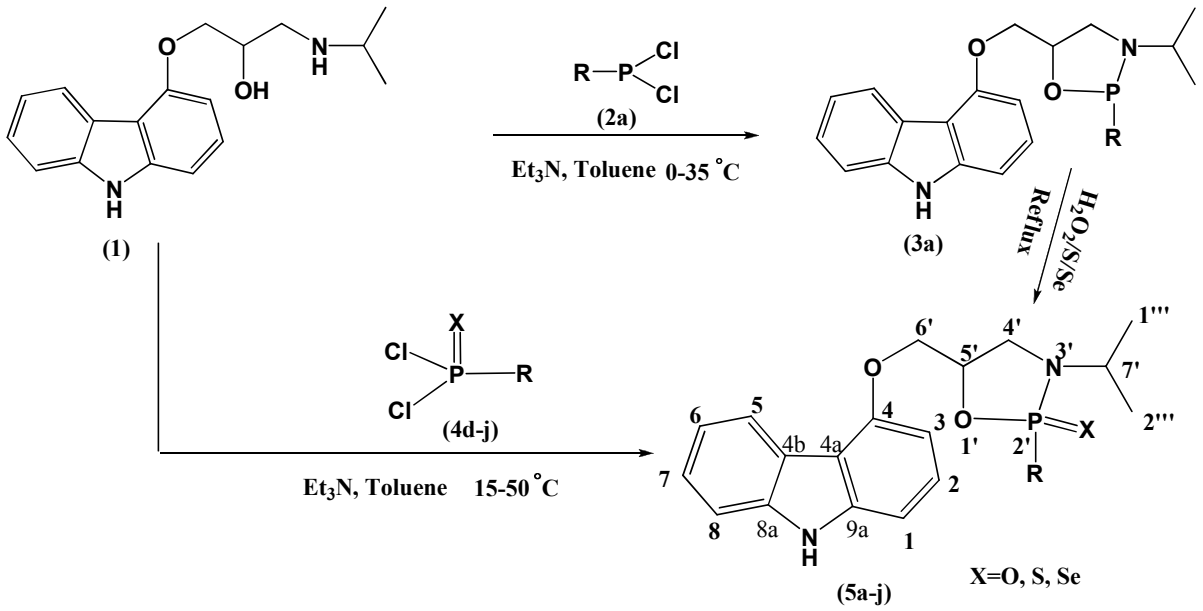
Other compounds (**5e-j**) were prepared following this procedure.

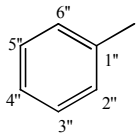
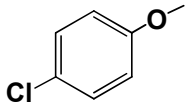
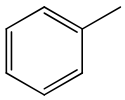
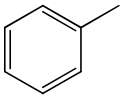
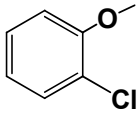
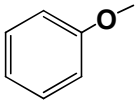
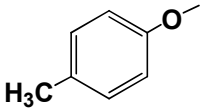
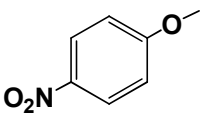
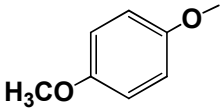
5-[(9*H*-4-Carbazolyloxy)methyl]-3-isopropyl-2-(4-nitrophenoxy)-1,2λ^5-oxazaphospholan-2-one (5e)

Yield: 83%; mp: 202-204 ºC; ir (potassium bromide): 3405, 1298, 1200, 958 cm^{-1}; ^{1}H nmr (deuteriochloromethane): δ: 9.99 (1H, s, Ar-NH), 7.80-6.46 (11H, m, Ar-H), 4.56-4.49 (2H, t, *J* = 7.2 Hz, OCH_2), 4.38-4.29 (1H, m, CH), 4.08-3.38 (3H, m, NCH_2, NCH), 1.37 (3H, d, *J* = 7.2 Hz, CH_3), 1.26 (3H, d, *J* = 7.3 Hz, CH_3); ^{31}P nmr (dimethyl sulfoxide): δ 25.37;. lcms: m/z 482 (25), $(M+1)^+$and 159 (100). *Anal.* Calcd. for $C_{24}H_{24}N_3O_6P$. C, 59.87; H, 5.02; Found C, 58.75; H: 4.89.

5-[(9*H*-4-Carbazolyloxy)methyl]-2-(4-chlorophenoxy)-3-isopropyl-1,2λ^5-oxazaphospholan-2-one (5f)

Yield: 76%; mp: 183-185 ºC; ir (potassium bromide): 3432, 1255, 1198, 964 cm^{-1}; ^{1}H nmr (deuteriochloromethane): δ 9.90 (1H, s, Ar-NH), 7.80-6.46 (11H, m, Ar-H), 4.56-4.49 (2H, t, *J* = 7.1 Hz, OCH_2), 4.38-4.29 (1H, m, CH), 4.08-3.38 (3H, m, NCH_2, NCH), 1.37 (3H, d, *J* = 7.2 Hz, CH_3), 1.26 (3H, d, *J* = 7.3 Hz, CH_3); ^{31}P nmr (dimethyl sulfoxide): δ 24.57; lcms: m/z 471 (16), $(M+1)^+$and 337 (100). *Anal.* Calcd. for $C_{24}H_{24}ClN_2O_4P$. C, 61.22; H, 5.14; Found C, 60.28; H: 5.07.



Compound	R	X	Compound	R	X
5a		**O**	**5f**		**O**
5b		**S**	**5g**		**O**
5c		**Se**	**5h**		**O**
5d		**O**	**5i**		**O**
5e		**O**	**5j**		**O**

Scheme 1: Synthesis of 5-[2-(9*H*-4- carbazolyl)ethyl]-3-isopropyl-2-phenoxy-1,3,2λ^5-oxazaphospholan-2-ones / thiones / selenones

2-(3-Bromophenoxy)-5-[(9*H*-4-carbazolyloxy)methyl]-3-isopropyl-1,2 λ^5-oxazaphospholan-2-one (5g)

Yield: 79%; mp: 215-217 ºC; ir (potassium bromide): 3390, 1265, 1185, 935 cm^{-1}; ^1H nmr (deuteriochloromethane): δ: 9.90 (1H, s, Ar-NH), 7.80-6.46 (11H, m, Ar-H), 4.56-4.49 (2H, t, *J* = 7.1Hz, OCH_2), 4.38-4.29 (1H, m, CH), 4.08-3.38 (3H, m, NCH_2, NCH), 1.37 (3H, d, *J* = 7.2 Hz, CH_3), 1.26 (3H, d, *J* = 7.3 Hz, CH_3); ^{31}P nmr (dimethyl sulfoxide): δ 28.70. *Anal.* Calcd. for $C_{24}H_{24}BrN_2O_4P$. C, 55.94; H, 4.69; Found C, 54.35; H: 4.58.

5-[(9*H*-4-Carbazolyloxy)methyl]-2-(2-chlorophenoxy)-3-isopropyl-1,2λ^5-oxaphospholan-2-one (5h)

Yield: 75%; mp: 193-195 ºC. ir (potassium bromide): 3387, 1268, 1200, 948 cm^{-1}; ^1H nmr (deuteriochloromethane): δ: 9.96 (1H, s, Ar-NH), 7.80-6.46 (11H, m, Ar-H), 4.56-4.49 (2H, t, *J* = 7.2 Hz, OCH_2), 4.38-4.29 (1H, m, CH), 4.08-3.38 (3H, m, NCH_2, NCH), 1.37 (3H, d, *J* = 7.2 Hz, CH_3), 1.26 (3H, d, *J* = 7.3 Hz, CH_3); ^{13}C nmr (deuteriochloromethane): δ 100.2 (C-1), 123.4 (C-2), 112.5 (C-3), 149.8 (C-4), 141.7 (C-4a), 104.9 (C- 4b), 120.8 (C-5), 122.6 (C-6), 121.7 (C-7), 112.5 (C-8), 126.4 (C-8a), 139.9 (C-9a), 154.6 (C-1"), 124.9 (C-2"), 130.7 (C-3"), 123.8 (C-4"), 128.9 (C-5"), 119.6 (C-6"), 69.9 (C-6", OCH_2), 77.8 (C-5", CH), 44.3 (C-4", CH_2), 44.9 (C-7' NCH), 24.3 (C-1'" & 2'", CH_3); ^{31}P nmr (dimethyl sulfoxide): δ 31.57; lcms: m/z 471 (45), $(M+1)^+$and 356 (100). *Anal.* Calcd. for $C_{24}H_{24}ClN_2O_4P$. C, 61.22; H, 5.14; Found C, 60.25; H: 5.09.

5-[(9*H*-4-Carbazolyloxy)methyl]-3-isopropyl-2-(4-methylphenoxy)-1,2λ^5-oxazaphospholan-2-one (5i)

Yield: 73%; mp: 145-148 ºC; ir (potassium bromide): 3407, 1245, 1195, 962 cm^{-1}; ^1H nmr (deuteriochloromethane): δ: 10.23 (1H, s, Ar-NH), 7.80-6.46 (11H, m, Ar-H), 4.56-4.49 (2H, t, *J* = 7.0 Hz, OCH_2), 4.38-4.29 (1H, m, CH), 4.08-3.38 (3H, m, NCH_2, NCH), 2.41 (3H, s, CH_3), 1.37 (3H, d, *J* = 7.2 Hz, CH_3), 1.26 (3H, d, *J* = 7.3 Hz, CH_3); ^{31}P nmr (dimethyl sulfoxide): δ 29.32; lcms: m/z 451 (25), $(M+1)^+$ and 347 (100). *Anal.* Calcd. for $C_{25}H_{27}N_2O_4P$. C, 66.66; H, 6.04; Found C, 65.92; H: 5.76.

5-[(9*H*-4-Carbazolyloxy)methyl]-3-isopropyl-2-(4-methoxyphenoxy)-1,2λ^5-oxazaphospholan-2-one (5j)

Yield: 78%; mp: 161-163 ºC. ir (potassium bromide): 3393, 1268, 1148, 955 cm^{-1}; ^1H nmr (deuteriochloromethane): δ: 9.93 (1H, s, Ar-NH), 7.80-6.46 (11H, m, Ar-H), 4.56-4.49 (2H, t, *J* = 7.2 Hz, OCH_2), 4.38-4.29 (1H, m, CH), 4.08-3.38 (3H, m, NCH_2, NCH), 3.76 (3H, s, OCH_3), 1.37 (3H, d, *J* = 7.2 Hz, CH_3), 1.26 (3H, d, *J* = 7.3 Hz, CH_3); ^{31}P nmr (dimethyl sulfoxide): δ 26.87. *Anal.* Calcd. for $C_{25}H_{27}N_2O_5P$. C, 64.37; H, 5.83; Found C, 64.18; H: 5.49.

RESULTS AND DISCUSSION

A new series of 5-[2-(9*h*-4-carbazolyl)ethyl]-3-isopropyl-2-phenoxy-1,3,2λ^5- oxazaphospholan-2-ones/ thiones/ selones (**5a-j**) were prepared by reacting 1-(9*H*-carbazol-4-yloxy)-3-(isopropylamino)propan-2-ol (**1**) with dichlorophenyl phosphine **(2a)** and phosphorodichloridates (**4d-j**) in the stirred solution of toluene in the presence of triethylamine initially at 0-10 ºC and later at 30-35 ºC under N_2 atmosphere. The reaction between 1-(9*H*-carbazol-4-yloxy)-3-(isopropylamino) propan-2-ol (**1**) and dichlorophenylphosphine **(2a)/** substituted phenylphosphoro dichloridates (**4d-j**) to form oxazaphospholane ring is a nucleophilic substitution reaction between the hydroxyl and exocyclic secondry amino group of **1** at the phosphorus atom of the phosphorus dichlorides **2a** and **4d-j.**

This reaction is chemoselective since only the exocyclic alkyl secondry amino group is involved in this nucleophilic substitution but not the carbazole NH group. This could be rationalized by the fact that the side chain NH is more nucleophilic when compared with that of carbazole NH since more electron density exists on it due to the positive inductive effect by the alkyl substituents. The situation is quite opposite in the case of carbazole NH since its lone pair of electrons are extensively delocalized into the aromatic π-conjugated system of the carbazole moiety by resonance. The reaction goes to completion very smoothly in toluene at 0-40 ºC in the presence of triethyl amine.

Condensation between the Corazolol **(1)** and dichlorophosphine (**2a**) goes rather slowly and takes about 2 h of time to form the corresponding 2-chloro-5-((9H-carbazol-4-yloxy)methyl)-3-isopropyl-2-phenyl-1,3,2-oxazaphospholidine intermediate (**3a**). Oxidation, thiation and selenation of **3a** under the same condition with H_2O_2, S and Se affords oxazaphospholane 2-one, 2-thione and 2-selenone respectively. Direct one - step cyclization between Corazolol (**1**) and the dichloridates (**4d-j**) under the same condition goes faster and completed in 1.5 hrs and formed the final products **5d-j** in high yields. Fast and facile cyclization of (**1**) with phosphorus dichloridates **4d-j** could be attributed to the more electrophilic character of phosphorus atom of the phosphorodichlorides (**4d-j**). All the crude products isolated from the reaction mixture after removing the solvent were purified by column chromatography using silica adsorbent and ethyl acetate, hexane solvent mixture as eluent. Analytically pure compounds were obtained by recrystallization from ethanol. These are white and pale yellow compounds with melting point range from 145-258 ºC and are soluble only in polar organic solvents. All compounds (**5a-j**) were screened for their antibacterial activity against *Staphylococcus aureus* and *Escherichia coli* by the disc-diffusion method in nutrient agar medium in dimethylformamide. The results were compared with the activity of the standard antibiotic Penicillin. These compounds showed moderate activity against bacteria. Among them compounds **5d**, **5g** and **5h** exhibited good activity.

The synthesized compounds **5a-j** gave satisfactory elemental analyses and these proposed structures are agreeable IR, ^{1}H, ^{13}C and ^{31}P and mass spectral data. The IR spectra of **5a-j** showed the expected absorption bands at 3432–3350 and 1300–1230 cm^{-1} for the NH, P=O stretching vibrations respectively [8]. The P=S and P=Se gave absorption at 790 cm^{-1} and 688 cm^{-1} respectively [9]. Characteristic absorption bands for P-O-(C_{arom}) and (P)-O-$C_{(arom)}$ stretching vibrations of the P-O-$C_{(arom)}$ group were observed in the region 965-935 and 1200-1178 cm^{-1} respectively [10,11]. The P-C bond [12] stretching absorption occurred in the region 1465-1480 cm^{-1}. In their ^{1}H NMR spectra, the aromatic protons resonated as multiplets at δ 8.27-6.50. The NH proton of the carbazole moiety gave a signal in the range of δ 10.0-9.90 [13]. In ^{13}C NMR, the methylene carbon (C-4') which is in the oxazaphosphole heterocyclic ring resonated in the region 46.6 - 45.3 ppm [14]. The absence of signals for the hydroxyl and amidic protons and the presence of a ^{13}C NMR signal for C-5' at δ 75.7-70.1 provide the most convincing evidence for the formation of the oxazaphosphole ring. The C-4'' resonated in the down field by δ 3-6 due to the deshielding effect of P=O group of the heterocyclic ring. In ^{31}P NMR, phosphorus-31 chemical shifts appeared obtained as singlets in the region δ 22.7–72.81 [15].

Antimicrobial activity: Compounds **5a-j** were screened for their antibacterial activity against *Staphylococcus aureus* and *Escherichia coli* (10^6 cells/mL) by the disc-diffusion method [9,10] in nutrient agar medium at two concentrations (250, 500 µg/disc) in dimethylformamide (DMF). These solutions were added to each filter paper disc and DMF was used as the control. The plates were incubated at 35 °C and examined for zone of inhibition around each disc after 24 h. The results were compared with the activity of the standard antibiotic Penicillin (250 µg/ disc).

Antibacterial activity of oxazaphospholidine derivatives (**5a-j**)

Compound	Zone of inhibition (mm)			
	Bacteria			
	Staphylococcus aureus		*Echerichia coli*	
	250 µg/disc	500 µg/disc	250 µg/disc	500 µg/disc
5a	16	18	11	15
5b	13	15	10	14
5c	14	16	12	14
5d	8	10	6	10
5e	12	13	13	17
5f	10	14	12	14
5g	8	10	10	12
5h	7	11	13	15
5i	15	19	15	17
5j	14	17	12	15
Penicillin[a]	20	--	20	--

[a]*Reference compound*

Examination of the structure-activity relationship of these compounds (**5a-j**) shows that their zone of inhibition is in the range from 6-18 mm on both the bacteria while the standard penicillin has the value of 20 mm. This results show that majority of these compounds **5a-j** possess significant antibacterial activity. It is observed that in compounds **5a**, **5c** and **5b** the antibacterial activity is highest in this series of compounds and it decreases in the order **5a**>**5c**>**5b** indicating that substitution of phosphoryl (P=O) group (**5a**) in oxazaphospholane ring system enhances antimicrobial activity when compared with thiophosphoryl (P=S) and selenophosphoryl (P=Se) group. Further, it is noted that the compounds with simple phenyl substitutent at the phosphorus of the oxazaphospholan ring (**5a**) has more antibacterial activity than the corresponding phenoxy derivatives (**5d-j**). Of them, the compounds with substitution by CH_3, OCH_3, NO_2 and Cl at the fourth position of the phenoxy group (**5i**, **5j**, **5e** and **5f**) showed significant antimicrobial activity.

CONCLUSION

Simple and efficient method for synthesis of new class of 5-[2-(9*h*-4-carbazolyl)ethyl]-3-isopropyl-2-phenoxy-1,3,2λ^5-oxazaphospholan-2-ones/ thiones/ selones (**5a-j**) was accomplished and all the title compounds showed moderate to high anti microbial activity at different concentrations.

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