Complexes of Nickel(II) with Peripherally Substituted Porphyrin; Synthesis, Spectral and Biological Evaluation

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Abstract-The synthesis of a series of new Nickel(II) porphyrin complexes, NiTMP(5-XSA), where 5-XSA(X=Cl, F, NO_2, NH_2) = substituted salicylate – the out planed ligand and TMP– the dianion of 5,10,15,20-tetrakis-p-methoxyphenyl-21H,23H-porphine is reported. The obtained complexes were characterized by elemental analysis, UV–Vis, vibrational spectroscopy, ^{1}H NMR and ESI Mass spectroscopy. The nature of substituent on the axial ligand is shown to affect the electronic absorption spectra. The data of ^{1}H NMR spectroscopy have allowed us to conclude that the salicylate ligand is in the *cis*-geometry to the porphyrin plane. The biological screening viz., *in vitro* antibacterial, DPPH radical scavenging activity and *in vitro* cytotoxicity of uncomplexed free base and corresponding metallated and axially ligated derivatives has also been carried out.

Index Terms— Axial ligand, Biological screening, Nickel(II) porphyrin, Salicylate.

1 Introduction

PORPHYRINS are the macrocycles with the electronic heart consisting of inner 16-membered conjugated system having planar geometry with 18 π electrons that are responsible for the characteristic, porphyrin-type optical spectra [1, 2] and have been the subject of intense study in the last century due to their wide distribution in nature, usually as metal complexes of either iron or magnesium [3]. As such, they serve as the prosthetic groups in a wide variety of primary metabolites, such as hemoglobin, myoglobin, cytochromes, catalases, peroxidases, chlorophylls, and bacteriochlorophyll [4,5]; these compounds have multiple applications in materials science, biology and medicine [6].

The multifaceted properties of porphyrin and metalloporphyrin make them versatile chromophore and are ubiquitous in nature. This versatile nature of porphyrin is attributed to; (i) the presence of a red-shifted main absorption band, the soret band, at 418 nm, (ii) intense extinction coefficients, e.g., ε in case of tetraarylporphyrin is around 440,000 [5], (iii) facile modification of substituent groups on several distinct functionalization sites, i.e., the meso-position, β-position and inner nitrogens (**Figure 1**) [7] and (iv) ease of metal incorporation into the porphyrin ring [8]. This article describes current methodology for preparation of simple, symmetrical model porphyrins, as well as more complex protocols for preparation of metallated and axially ligated porphyrin macrocycles. *Meso*-5,10,15, 20-tetrakis(*p*-methoxyphenyl) porphyrin (TMP) was chosen as the basic core. The addition of spectrally pure, free base TMP with nickel acetate yielded the corresponding nickel(II)-porphyrins and their subsequent reaction with different salicylates as axial ligands results in the formation of axially ligated Ni(II) porphyrins. The free base porphyrin, its corresponding metallated and its axially ligated Ni(II) derivatives were characterized by various spectroscopic techniques. Biological activity of all the synthesized complexes was also screened.

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2 Material and Method

2.1 General

All the chemicals were of analytical grade and used as received unless otherwise noted. Pyrrole was distilled over potassium hydroxide pellets under vacuum prior to use. All the organic solvents that were used for the synthesis and for chromatographic separations were dried before use. Thin layer chromatography was performed on pre coated TLC Silica gel_{60} on aluminium sheet, purchased from Merck. Column chromatography was carried out on silica gel (100-200 mesh) purchased from Merck. Nuclear magnetic resonance (NMR) spectra were obtained on Bruker 400 MHz in $CDCl_3$ using tetramethylsilane as internal standard.

2.2 Synthesis and Characterization

The general synthetic procedure used here for the synthesis of symmetrically substituted porphyrin (***Scheme 1***) is based on the experimental set-up previously reported by Adler-Longo method [9]. This method comprises condensation of equimolar mixture of pyrrole and corresponding benzaldehyde in refluxing propionic acid.

2.2.1 *Synthesis of meso-5,10,15,20-Tetakis(p-methoxyphenyl)-21H,23H-porphyrin, TMP*

4-methoxybenzaldehyde (0.475mL, 4 mmol) and freshly prepared pyrrole (0.27 mL, 0.40g, 4 mmol) were added dropwise in a boiling propionic acid and was refluxed for 30 minutes. The tarry insoluble product was filtered and residue was washed several times with hot water and methanol till the blackish residue becomes clear. The product was purified on a silica column using 1:1 mixture of hexane-ethyl acetate as eluent. The resultant solution was evaporated to dryness in a rotary evaporator fitted with a vacuum pump. The purple shiny crystals of TMP were obtained with 19% yield. The Rf value of silica gel coated plate was found to be 0.45.

Anal. Calc. for $\mathbf{C_{48}H_{38}N_4O_4}$ (%): C 78.44, H 5.17, N 7.62. Found: 78.5, H 5.11, N 7.52. Uv-Vis. λ_{max} (dichloromethane, nm) 421, 518, 557, 593 and 651. ^{1}HNMR ($CDCl_3$, tetramethylsilane) δ= -2.76 (brs, 2H, N–$H_{pyrrole}$), 4.08 (s, 12H, Ar-OCH_3), 7.26 (d, 8H, J = 8.5 Hz, 5,10,15,20Ar 3,5-H), 8.10 (d, 8H, J = 8.5 Hz, 10,15,20-Ar 2,6-H), 8.8–8.90 (s, 8H, pyrrole). MS [m/z] 734.3 (M^+) (734.28 calculated for $C_{48}H_{38}N_4O_4$).

2.2.2 *Synthesis of meso-5,10,15-20-Tetakis(p-methoxyphenyl) Ni(II)porphyrin, NiTMP*

NiTMP was synthesized according to a previously reported procedure [10]. A solution of TMP (0.203 g, 0.26 mmol) in 50mL $CHCl_3$ and $Ni(OAc)_2.6H_2O$ (0.570 g, 2.6 mmol) dissolved in minimal quantity of methanol in 1:10 molar ratios was stirred for 16 h in the dark. After the complete metalation was confirmed by TLC, the mixture was poured into 100 ml water and extracted with $CHCl_3$, the organic layer was washed with water and brine and dried over anhydrous $MgSO_4$. The solvent was removed under reduced pressure and the residue was recrystallized in $CHCl_3$/MeOH to get purple crystal.

Anal. Calc. for ***$NiC_{48}H_{36}N_4O_4$*** (%): C 72.63, H 4.79, N 7.06. Found: C 73.01, H 4.27, N 7.09. Uv-Vis. λ_{max}(dichloromethane, nm) 426,559 and 597. ^{1}HNMR ($CDCl_3$, tetramethylsilane) δ = 4.11 (s, 12H, Ar-OCH_3), 7.30 (d, 8H, J = 8.5 Hz, 5,10,15,20 Ar 3,5-H), 8.14 (d, 8H, J = 8.5 Hz, 10,15,20-Ar 2,6-H), 8.8–8.93 (s, 8H, pyrrole). MS [m/z] 793.2 (M^+) (792.99 calculated for $NiC_{48}H_{38}N_4O_4$).

2.2.3 *Synthesis of axially ligated Nickel(II) porphyrins complexes [NiTMP(5-XSA)]*

NiTMP (0.15 mmol) in 25 ml $CHCl_3$ was treated with respective salicylic acid (0.60 mmol) in 25ml CH_3OH, stirred under reflux for 12 h [11] and a colour change was observed. The reaction mixture after concentration, extracted four times with distilled water and then, it was filtered through anhydrous Na_2SO_4. The compound was recrystallized from dichloromethane-hexane solution (1:1). The same procedure was applied for the synthesis of all axially ligated nickel(II) porphyrin complexes as described above. All the reaction was done under nitrogen atmosphere. The purified axially ligated zirconium porphyrin complexes were obtained in yields of 40- 45%.

2.2.3.1 NiTMP(5-ClSA)

Bright red solid; Anal. Calcd. (%) for $\mathbf{C_{55}H_{39}ClN_4O_7Ni}$: C 66.40, H 3.95, N 5.63; Found (%): C 66.85, H 3.69, N 5.45; UV-vis spectra($CHCl_3$)λ_{max}: 422 nm (Soret band), 553 nm, 593 nm (Q-band). ESI-MS (CH_3OH:CH_3CN): m/z calcd. for $C_{55}H_{39}ClN_4O_7Ni$: 994.60; found 995.23 ($[M^+H]^+$; IR (KBr)ν_{max}: 478 cm^{-1} (ν_{Ni-N}), 720 cm^{-1} (ν_{Ni-O}, carboxylic SA); ^{1}H NMR (500 MHz, $CDCl_3$, δ ppm): 8.97 (8H, s, β-H), 8.54-8.56 (4H, s, *o*-phenyl), 8.15-8.12 (4H, d, *o*-phenyl), 7.74-7.68 (8H, m, *m*-phenyl), 4.07 (s, 12H, *p*-OCH_3), 7.17-7.15 (1H, d, 3-phenyl SA), 7.10-7.08 (1H, d, 4-phenyl SA), 7.26 (1H, s, 6-phenyl SA).

2.2.3.2 NiTMP(5-FSA)

Dark red solid; Anal. Calcd. (%) For $\mathbf{C_{55}H_{39}FN_4O_7Ni}$: C, 67.53; H, 4.02; N, 5.73; Found (%): C, 67.55; H, 4.11; N, 5.65; UV-vis spectra($CHCl_3$)λ_{max}: 423 nm (Soret band), 553 nm, 590 nm (Q-band). ESI-MS (CH_3OH:CH_3CN): m/z calcd. for $C_{55}H_{39}FN_4O_7Ni$ 978.15; found 979.56 ($[M^+H]^+$); IR (KBr)ν_{max}: 478 cm^{-1} (ν_{Ni-N}), 725 cm^{-1} (ν_{Ni-O}, carboxylic SA); ^{1}H NMR (500 MHz, $CDCl_3$, δ ppm): 9.01 (8H, s, β-H), 8.56-8.54 (4H, d, *o*-phenyl), 8.32-8.30 (4H, d, *o*-phenyl), 7.78-7.66 (8H, m, *m*-phenyl), 4.10 (s, 12H, p-OCH_3), 7.25-7.23 (1H, d, 3-phenyl SA), 6.91-6.95 (1H, m, 4-phenyl SA), 7.32 (1H, s, 6-phenyl SA).

2.2.3.3 NiTMP(5-NH_2SA)

Reddish brown solid; Anal. Calcd. (%) $\mathbf{C_{55}H_{41}N_5O_7Ni}$: C, 67.74; H, 4.24; N, 7.18; Found (%): C, 67.83; H, 4.81; N, 7.25; UV-vis spectra($CHCl_3$)λ_{max}: 421 nm (Soret band), 548 nm, 593 nm (Q-band). ESI-MS (CH_3OH:CH_3CN): m/z calcd. for $C_{55}H_{41}N_5O_7Ni$: 975.17; found 976.24 ($[M^+H]^+$); IR (KBr)ν_{max}: 462 cm-1 (ν_{Ni-N}), 724 cm^{-1} (ν_{Ni-O}, carboxylic SA); ^{1}H NMR (500 MHz, $CDCl_3$, δ ppm): 8.98 (8H, s, β-H), 8.27-8.25 (4H, d, *o*-phenyl), 8.13-8.11 (4H, d, *o*-phenyl), 7.73-7.65 (8H, m, *m*-phenyl), 4.01(s, 12H, *p*-OCH_3), 7.18-7.16 (1H, d, 3-phenyl SA), 6.90-6.88 (1H, d, 4-phenyl SA), 7.24 (1H, s, 6-phenyl SA).

2.2.3.4 NiTMP(5- NO_2SA)

Brown solid; Anal. Calcd. (%) for **$C_{55}H_{41}N_5ONi$**: C, 67.74; H, 4.24; N, 7.18; Found (%): C, 67.65; H, 4.21; N, 7.25; UV-vis spectra($CHCl_3$)λmax: 424 nm (Soret band), 554 nm, 595 nm (Q-band). ESI-MS (CH_3OH:CH_3CN): m/z calcd. for $C_{55}H_{41}N_5ONi$: 975.17; found 976.05 ($[M^+H]^+$); IR (KBr)ν_{max}: 464 cm^{-1} (ν_{Ni-N}), 724 cm^{-1} (ν_{Ni-O}, carboxylic SA); ^1H NMR (500 MHz, $CDCl_3$, δ ppm): 9.09 (8H, s, β-H), 8.53-8.51 (4H, d, *o*-phenyl), 8.09-8.07 (4H, d, *o*-phenyl), 7.76-7.62 (8H, m, m-phenyl), 4.17 (s, 12H, H_{OCH3}), 7.22-7.20 (1H, d, 3-phenyl SA), 6.92-6.90 (1H, d, 4-phenyl SA), 7.29 (1H, s, 6-phenyl SA).

2.3 Biological Evaluation

2.3.1 Antibacterial Activity

The *in vitro* antibacterial and antifungal activities of the synthesized compounds were investigated by agar-disc diffusion technique according to Bauer *et al.*[12] at 100µg/mL concentration against various microbial strains. The potency of compounds was determined against the three gram-positive bacteria, *Bacillus subtilis* (MTCC-3401) and *Staphylococcus aureus* (MTCC-87) and *Micrococcus luteus* (MTCC-106) and two gram-negative bacteria, *Escherichia coli*(MTCC-118), *Achromobacter denitrificans* (MTCC-299). Pure culture of the organisms was obtained from School of Biotechnology, University of Jammu, India. The antibacterial activities were evaluated as per National Committee for Clinical Laboratory Standards guidelines (NCCLS 1997). The filter paper sterilized discs saturated with measured quantity of the sample (100 µg/mL) were placed on Nutrient agar plate containing solid bacterial medium (Muller Hinton agar/broth) and fungal medium (Potato dextrose agar). The assay plates were incubated overnight at 37°C for bacteria. After incubations, the diameters of the clear zones of growth inhibition surrounding the sample were measured in millimeters with a ruler and compared with standard antibiotic.

2.3.2 DPPH Radical Scavenging Assay

The free radical scavenging abilities of the porphyrin ligand and its metal complexes have been determined by their interaction with the stable free radical 2, 2′-diphenyl-1-picryl hydrazyl. *1,1-diphenyl-2-picrylhydrazyl (DPPH) radical scavenging assay*. Radical Scavenging Activity (RSA) was assessed using a purple colored methanol solution of DPPH radical which was first bleached and then measured for free radical rummage. The radical rummage was determined according to the reported method of Blois et al. [13] with modifications. A mixture consisting of 1ml 0.5 mM methanol solution of the DPPH radical, 2ml of the complex sample and an equal quantity (2ml) of 0.1 M sodium acetate buffer at pH of 5.5 was stirred at room temperature in dark for half an hour. The absorbance of the mixture was measured using UV-Vis spectrophotometer at 517 nm as standard wavelength. The free radical rummage was calculated as a percentage of DPPH radical discoloration, using the standard established equation:

$$\%RSA = [(A_0 - A_s)/A_0] \times 100$$

where, A_0 is the absorbance of the control and A_s is the absorbance of the test compound.

3 Results and Discussion

3.1 Synthesis and characterization

Free base porphyrin (TMP) i.e., meso-5,10,15,20–tetrakis(4-methoxyphenyl) porphyrin was prepared according to a literature procedure developed by Adler and Longo [9]. The compound was obtained in good yield and purified using silica gel column. TMP was used as a precursor for carrying out the metallation with $Ni(OAc)_2.6H_2O$, leading to the formation of NiTMP i.e., meso-5,10,15,20–tetrakis(4-methoxyphenyl)Nickel(II) porphyrin. The complex obtained in this way was treated with different substituted salicylic acid viz., 5- chlorosalicylic acid, 5-fluorosalicylic acid, 5-aminosalicylic acid and 5-nitrosalicylic acid resulting in the coordination of these salicylates at the axial position of the porphyrin core. These ligands were chosen because they contain chelating groups which increase the stability of mixed ligand complexes of this kind and moreover they can change both the spatial and electronic properties of these complexes. All synthesized compounds are colored and dissolve in most of polar organic solvents with better solubility than the starting complex. The synthesized complexes are water insoluble. Purification of the synthesized axially ligated salicylates complexes was carried out using column chromatography. Completion of the reaction was checked by TLC. Spectroscopic characterization was carried out involving different spectroscopic techniques like elemental analysis, absorption spectroscopy, vibration spectroscopy, nuclear magnetic resonance spectroscopy and mass spectrometry. The synthesized complexes were screened for biological evaluation like antibacterial, antifungal and radical scavenging activities. The synthesized complexes possess good biological activities.

The purity of Ni(II) metalloderivatives of TMP containing different substituted salicylates coordinated on the axial positions were characterized by their elemental analysis. Elemental analyses give satisfactory results for ligand and its metal complexes. CHN values are in close agreement with the expected molecular formulae assigned to the ligand and its metal complexes. By this method, the percentage of carbon, hydrogen and nitrogen in various axially ligated Ni(II) porphyrin was determined which agrees well with their calculated percentages. The mass and elemental analysis data are presented in the experimental section.

The optical absorption spectra is an important spectral phenomenon to distinguish between the free-base porphyrins and

their metalloderivatives. The spectrum changes from four-banded to a two-banded spectrum on metalation. This dramatic effect is attributed to the enhancing of the D_2h symmetry of the free-base porphyrin to D_4h on metalation. For porphyrin free bases, a very sharp intense band called B-band or soret band, appears around 400 nm in the near UV region with molar absorbance of 10^5 M^{-1} cm^{-1}, and four absorption bands called Q bands, responsible for the red to purple color, are present in the visible region between 500-700 nm with usually one order of magnitude lower intensities [14]. The soret band positions are sensitive to substituent groups, e.g., the soret band of 5,10,15,20-tetraphenylporphyrin is around 419 nm [15], while that of 2,3,7,8,12,13,17,18-octaethylporphyrin is around 400 nm [16].

Both the Soret and Q-bands of the NiTMP are red-shifted compared with free base porphyrin precursor, TMP. The broadening and red shifting of the absorption bands are usually an indicator of mixing with the intramolecular charge-transfer character in π–π* absorption bands. Further, the axially ligated complexes also exhibited prominent red shift in their spectra according to the larger out of plane distance and even the axially ligated complexes resulting in the higher distortion of the porphyrin ligand.
The IR spectra of TMP and and its metallo- and axially ligated derivatives exhibit several diagnostic vibrational frequencies of respective functional groups. The characteristic infrared spectral band of the free base porphyrin, TMP exhibit very sharp peak located at ~3400-3320 cm^{-1} and ~960 cm^{-1} respectively [17], corresponds to ν(N-H) stretching and bending frequencies. When the nickel(II) ion was inserted into the porphyrin ring, the N-H vibration frequency of free base porphyrins disappeared and the characteristic ν(Ni-N) vibration frequency found at ~550-500 cm^{-1}, indicating the formation of nickel(II) porphyrin complex. In the spectra of all the axially ligated nickel(II) porphyrin complexes the band due to ν(O-H) of the ligand disappeared indicating the co-ordination of carboxylic oxygen of respective salicylates to the metal via deprotonation [18]. Further the band observed near 650 cm^{-1} is assigned to ν(Ni-O) stretching frequency. The free O-H frequencies ν(O-H) of phenolic group present in the salicylates remain intact and observed at 3418 cm^{-1} confirming the coordination of axial ligand through carboxylate oxygen atom. Thus, the nickel atom in the centre of porphyrin ring coordinate with the salicylate group axially to form pentacoordinated complex of Ni(II) porphyrin.

In order to gain some insight on the confirmation of metallation of TMP, we examined the ^{1}HNMR spectra of the free base porphyrin precursor, TMP and its metalloderivative, NiTMP, upon comparison, it has been observed that the first signal appearing at high field (≈ -2.8 ppm) in case of free base porphyrin disappears upon metallation. Concerning the change of the chemical shifts of the other signals, no general rule could be drawn for metalloporphyrins. However, it is highly dependent on the structure symmetry.
The ^{1}H NMR spectra of a porphyrin is highly characteristic, this is because, as an aromatic cycle, the porphyrin macrocycle has an important cycle current that affects mainly the chemical shift of the protons. The imino protons present inside the rings are highly shielded (chemical shift around -3ppm), where as the protons of the beta and meso carbons are highly deshielded (chemical shift ≈ 7 ppm). The shielding experienced by N-H protons in the centre of the porphyrin ring are also affected by the number of nitrophenyl groups, Increasing the number of nitro groups leads to the expected high frequency shift of the N-H signal.
TMP exhibits a typical singlet at -2.8 ppm, corresponding to two N-Hs, and a set of three resonances in the aromatic region. Upon addition of 10 equivalents of corresponding metal salts the NH sharp peak disappeared, confirming the insertion of metal inside the porphyrin cavity and the aromatic region also underwent a slight shift relating to distortion of symmetry. TMP's multiplets at 7.8 and 8.2 ppm partially shifted downfield to 8.0 and 8.6 ppm, respectively; whereas the singlet at 8.9 ppm shifted upfield to 8.7 ppm.
Mass spectrometric characterization of NiTMP(5-XSA) complexes employed ESI as soft ionization technique. The mass spectra of axial ligated nickel(II) porphyrins with salicylates derivatives were characterized by the presence of the molecular ion peak for monomeric form followed by a degree of fragmentation when employing this technique, which suggested that axial ligand was labile. In addition, the intensities of the registered peaks are significantly higher. The base peak of nickel(II)-porphyrins complexes was observed 100 % intense giving evidence about the stability of complexes of nickel(II) porphyrins. The obtained ESI-MS data display that the molecule of axially ligated nickel(II)-porphyrins contain one or two molecules of solvent coordinated to the central nickel atom, which are not labile sufficiently and present in almost all the molecular ions. This fact can be explained by coordinated unsaturation of nickel atom.

3.2 Biological Study

3.2.1. Antibacterial activity

The results are represented in **Table 1** for antibacterial activities. The synthesized compounds showed varying degree of inhibitory effects; low (up to 10 mm), moderate (up to 15 mm) and significant (above 15 mm). The solvent, DMSO, used to prepare compounds solution did not show any inhibitory effect against the tested microbial strains. The uncomplexed porphyrin precursor, TMP, posses no activity against bacterial

strains at 100µg/mL. However, under similar conditions, the corresponding metalloderivatives (NiTMP) exhibit weak to moderate activity. It is interesting to note that upon axial coordination of NiTMP with different salicylates ligand, the complexes exhibit improved bioactivity. Here, NiTMP(5-ClSA) showed inhibitory effect only against two gram positive bacterial strain viz., *S. aureus* and *M. luteus* whereas, NiTMP(5-FSA) have very good zone of inhibition against both the bacterial strains. NiTMP(5-NH_2SA) with lesser diameter of zone of inhibition against a single bacterial strain compared to positive control.

It has been observed that, the NiTMP(5-NO_2SA) having NO_2- groups as a substituent on the salicylate ligand exhibit enhanced bioactivity as compared to other porphyrins analogs. The complex is showing efficient antibacterial activity against all the microbial strains except *S. aureus* and *A. denitrificus*, possessing good structure activity relationship.

3.2.2. *Antioxidant study*

Primarily, DPPH is a stable free radical that is often used for the detection of radical rummage/activity in chemical analysis. Antioxidants can induce a marked decrease in the absorption capability of DPPH radicals and the same was observed at 517nm which shows the trends in their reduction capabilities. TMP and its corresponding metal complexes were evaluated for DPPH radical scavenging activity. The antioxidant activity increases with increase in its concentration and also upon metallation. We got encouraging and promising results from the antioxidant studies of axially ligated nickel(II)porphyrin complexes with IC_{50} values of 50µg/ml and 65µg/ml respectively as tabulated below (**Table 1**). These complexes showed remarkable rummage with radical rummage/activity with lowest IC_{50} values whereas on the other hand, the free base porphyrin, TMP and NiTMP show very less antioxidant behavior with large IC_{50} values.

3.2.3. *In vitro* Cytotoxicity

The *in vitro* cytotoxic behavior of uncomplexed ligand precursor, TMP and corresponding metal derivatives was evaluated against four human cancer cell lines of different tissues *viz*., Breast (TA7D), Glioblastoma (T98G), Prostate (PC-3) and Lung (A-549) at 1×10^{-4} M as shown in **Table 2**. Growth inhibition was calculated as a measure of percentage and observed against all the cancer cell lines. Among all the compounds studied only the [NiTMP(5-NO_2SA)] complex showed prominent *in vitro* cytotoxic activity against all the cancer cell lines, the percent growth inhibition was found to be 47% against Breast (TA7D), 39% against Glioblastoma (T98G), 43% against Prostate (PC-3) and 51% against Lung (A-549) human cancer cell lines respectively. Rest of the compounds showed moderate percent growth inhibition i.e., in the range 11% to 38% against various cancer cell lines.

3 Conclusion

The synthesized complexes were tested for biological activities viz.; *in vitro* antimicrobial screening, DPPH radical scavenging assay and *in vitro* cytotoxicity.

The axially ligated nickel(II) porphyrin complexes with salicylates and its derivatives were synthesized and their *in vitro* antibacterial and anticancer potential was evaluated. Antibacterial results obtained showed that the synthesized compounds have higher activity than the corresponding porphyrin ligand, but lower activity then the standard drug. The above synthesized compounds were characterized by well-established elemental analysis, UV/visible, IR spectroscopy, ^{1}H NMR and ESI Mass spectroscopy.

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