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Synthesis of New *meso*-Porphyrins Type A_2 B_2 †

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Abstract: New *meso*-bis(quinolin-3-yl) porphyrins derivatives were synthetized from quinolin-3-carboxaldehydes derivatives and dipyrromethane in 1:1 ratio in CH_2Cl_2 at room temperature catalyzed by TFA and DDQ. Synthetized porphyrins were obtained with a low yield.

Keywords: quinoline; porphyrins; dipyrromethane

1. Introduction

The porphyrin core has been a fascinating heterocyclic organic macrocycle as an interesting building unit for the design of new supramolecular assemblies and coordination polymers [1]. The extremely remarkable properties of highly conjugated macrocycles have led to their unique roles in diverse fields ranging from photomedicines [2] to dye sensitized solar cells that are well addressed in recent reviews [3–5]. Substituted nitrogen heterocyclic porphyrins are of particular interest [6]. As they provide sites for metal coordination, hydrogen bonding, alkylation and modulating electronic properties [7]. Several quinoline derivatives have been found to possess useful biological activities such as bactericidal [8], antitumor [9], antimalarial [10], antinflamatory [11]. The benzo and hetero fused quinolines are known to bind to DNA topoisomerase and display cytotoxic and antitumor activities [12].

2. Materials and Methods

2.1. Instrumentation and Reagents

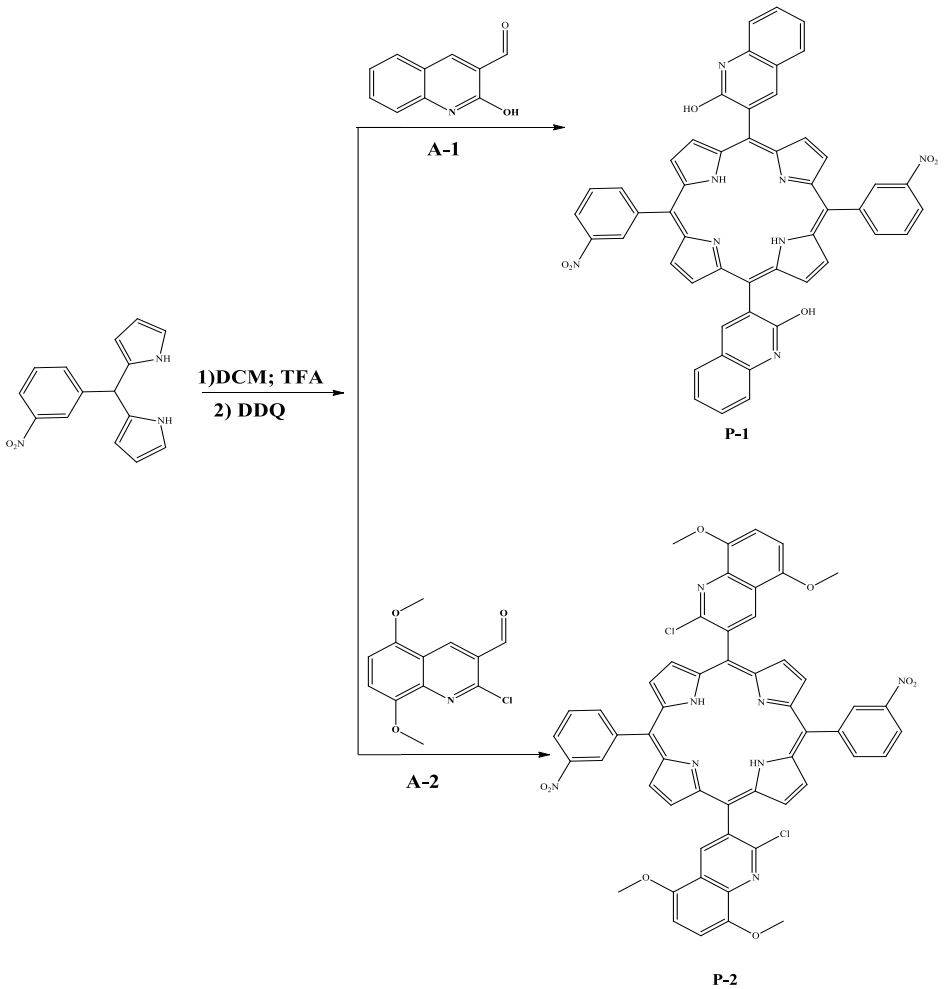
Solution Unless otherwise mentioned, all the reagents and solvents were purchased from Aldrich, Acros Organics or Merck and used without further purification. ^1H and ^{13}C NMR spectra were recorded on Bruker Avance 500 (500.13 and 125.76 MHz, respectively) spectrometer. $CDCl_3$ was used as solvent and tetramethylsilane (TMS) as internal reference; the chemical shifts are expressed in δ (ppm) and the coupling constants (*J*) in Hertz (Hz). Unequivocal ^1H assignments were made using 2D COSY ($^1H/^1H$), whereas ^{13}C assignments were made on the basis of 2D HSQC ($^1H/^{13}C$) and HMBC (delay for long-range *J* C/H couplings were optimized for 7 Hz) experiments. Mass spectra were recorded using MALDI TOF/TOF 4800 Analyzer, Applied Biosystems MDS Sciex, with $CHCl_3$ as solvent and without matrix. Mass spectra HRMS were recorded on APEXQe FT-ICR (Bruker Daltonics, Billerica, MA, USA) mass spectrometer using $CHCl_3$ as solvent; in m/z (rel. %). Column chromatography was carried out using silica gel (Merck, 35–70 mesh).

2.2. Synthesis of Porphyrins

Aldehyde (100 mmol) and dipyrromethane (200 mmol) were dissolved in DCM (40 mL) and stirred for 2 mins followed by addition of trifluoroacetic acid (5 μL). The reaction mixture was stirred under nitrogen atmosphere for 4 h at room temperature in dark. After that 2,3- dichloro-5,6-dicyano-1,4-benzoquinone (DDQ, 300 mmol) was added and reaction mixture was stirred for another 3 h under air. Formation of the desired porphyrin was identified by Observation of brown color spot on TLC (in 30% DCM/hexane). The crude reaction mixture was subjected to silica gel column to filter off excess DDQ and other oligomeric products using 100% DCM. Further purification was carried out with a neutral alumina column chromatography and the desired porphyrins (**P-1, P-2**) were eluted with 20–30% DCM/hexane.

3. Results and Discussion

The synthesis of new macromolecules type *trans*-A_2B_2 porphyrins possessing aromatic moieties as 2-hydroxy-quinoline and 2-chloro-5,8-dimethoxyquinoline were synthesized within two reaction steps (Scheme 1). In the first step, key precursors, 3-nitrophenyl dipyrromethane and aromatic aldehydes **A-1**, **A-2** were synthesized following literature reported conventional procedure [13], involved the synthesis of *trans*-A_2B_2-porphyrins via condensation of aryl aldehydes with meso-aryl dipyrromethane in the presence of trifluoroacetic acid (TFA) followed by treatment with 2,3-dichloro-5,6-dicyano-1,4-benzoquinone (DDQ) as an oxidizing agent.



Scheme 1. Formation of *trans*-A_2B_2 porphyrins**.**

Starting quinoline aldehydes was synthesized by Vilsmeier–Haack cyclization [14] and meso-dipyrromethane by modified procedure literature [15].

The reaction of aldehydes, with dipyrromethane gave rise to the corresponding porphyrin with a low yield of **P-1** and trace amount of **P-2**. Evaluation of reaction was followed by TLC and UV spectrophotometer. The desired A_2B_2-porphyrins, **P-1**, **P-2** were identified by ^{1}H-NMR and mass spectroscopy.

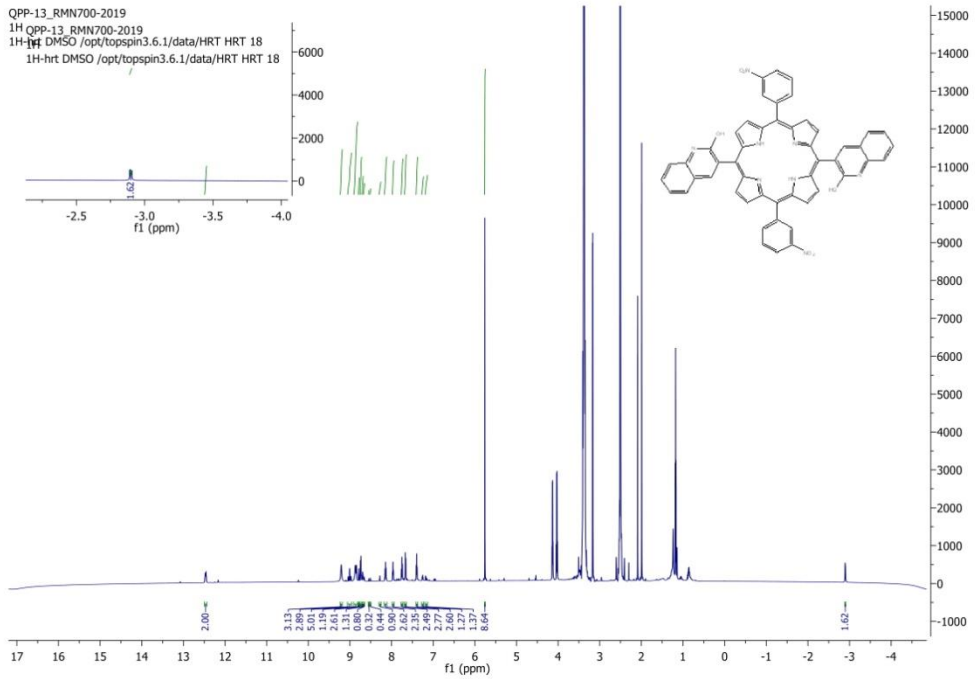


Figure 1. ^{1}HNMR spectra of porphyrin **P-1.**

The ^{1}HNMR spectra of *Trans*-A_2B_2 porphyrins reflect signals due to β-pyrrolic protons and *meso*-arylic protons at low field region from δ 7.17 ppm to δ 8.16 ppm corresponding to *meso*-arylic protons and from δ 8.69 ppm to δ 9.04 9.21 ppm due to β- pyrrole, when the hydroxy group appeared at 12.47 ppm. The protons of the inner N-H groups resonate at very high field from δ −2.84 to −2.9 ppm.

4. Conclusions

In summary, we report the synthesis of *trans*-A_2B_2 porphyrins can be effectively synthesized from dipyrromethanes and quinoline aldehyde derivatives. Usually, the low yield of this reaction is being studied in order to improve it, as well as the use of other type of aldehydes is being carried out.

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Conflicts of Interest: The authors declare no conflict of interest.

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