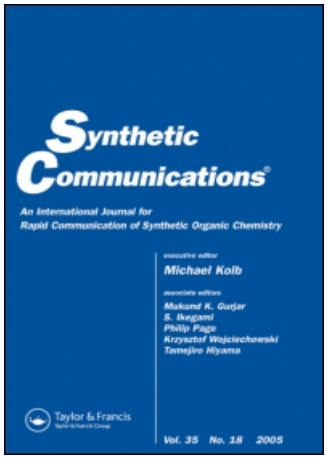

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Preparation of **meso**-Tetraarylporphyrins Nitrated in Two Neighboring Aromatic Rings

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Preparation of *meso*-Tetraarylporphyrins Nitrated in Two Neighboring Aromatic Rings

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ABSTRACT

Selective nitration of tetraphenylporphyrin (TPP) and its derivatives is reported. The reaction of *meso*-aryl substituted porphyrins with fuming yellow nitric acid ($d = 1.53$) at the temperature 0–20°C results in the formation of 5,10-bis(4-nitroaryl)-15,20-diarylporphyrins with yields of 30–83%.

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Key Words: *meso*-Tetraarylporphyrins; 5-10-bis(4-Nitrophenyl)-15, 20-diphenylporphyrin and its derivatives; Nitration.

Selective functionalization of easily available TPP (and its derivatives) is of significant importance due to their potential use as photosensitizers in Photodynamic Therapy (PDT).[1] From this process, the hydrophobic moieties can be transformed into the lipophilic compounds. The latter, as such, being soluble in the physiological milieu, may be considered as potential PDT agents. One of the most versatile substituents for this purpose is a nitro group, lending the possibility for further transformations.[2]

Direct nitration of tetraarylporphyrins and their metal complexes usually occurs in the β-positions in pyrrole units.[3] In 1989, Kruper et al.[4] described the selective mono-nitration in position *para*- of one phenyl ring of TPP. They investigated the possibility of the introduction of an additional NO_2 group to another phenyl ring; however, this was practically limited to one case of an electron-enriched *meta*-tolyl substituent only, with the use of inconvenient, expensive, and dangerous red fuming nitric acid (containing 12–24% of N_2O_4). Moreover, they unfortunately obtained a mixture of two different dinitro-compounds: 5,10-bis(3-methyl-4-nitrophenyl)-15,20-bis(3-methylphenyl)porphyrin and 5,15-bis(3-methyl-4-nitrophenyl)-10,20-bis(3-methylphenyl)porphyrin. On the other hand, the direct synthesis of porphyrins, substituted with electrophilic aryl rings in positions *meso*-, by the Rothemund synthesis[5] (and its cross-condensation modifications[6]), from the corresponding aldehyde(s) and pyrrole, is an extremely difficult task (yields $<3\%$).[7] It is improbable that the synthesis of porphyrins, substituted by the nitro groups in two *meso*-aryl rings, can be effectively realized by this method.

Herein, we would like to present method for the selective nitration of *meso*-tetraarylporphyrins in two neighboring aromatic rings. We found that it could be realized with the use of fuming yellow nitric acid ($d = 1.53$) when the temperature is manipulated. First, the reaction is carried-out at 0–5°C until disappearance of the substrate, then the temperature is raised slightly to room temperature and the reaction is continued for completion (monitored by TLC).

We used for this purpose readily available TPP,[8] and other tetraarylporphyrins, with a variety of aromatic ring substituents, each containing different kinds of electron-drawing properties (e.g., hydrogen, methyl, methoxy, and chlorine; both in the 2- and in 3-positions). In every above reaction, the nitration occurred selectively in position 4- (for TPP and 3-substituted rings; probably in position 5- for 2-methoxy-substituted

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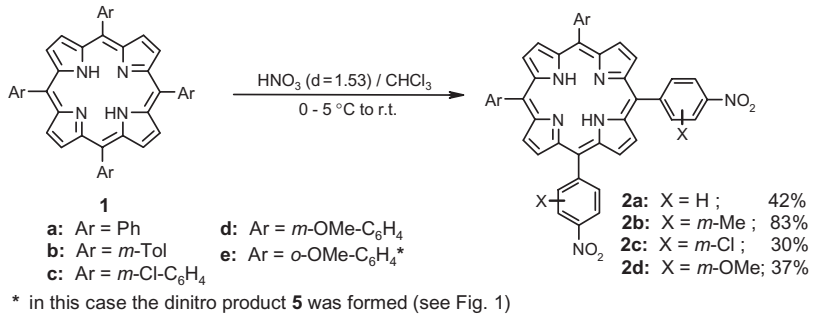

Scheme 1.

derivative **1e**) to give the compounds **2a–d** as main products with satisfactory yields (30–83%).

For TPP, small amounts of the mono-nitration product, **3**, were observed (6%). In the case of the electron-withdrawing substituent, -Cl, the nitration proved somewhat troublesome. Finally, the use of the large excess HNO_3 within a short interval (4 min) gave a mixture of nitro-compounds from which **2c** was isolated as the major product. Moderate amounts of the mono-nitrated derivative, **4**, were also found. Prolonging the reaction time in this case allows for the exhaustive conversion of the mono-nitrocompound into the desired product **2c**; however, it also led to the partial degradation of this product, decreasing the overall yield.

The structures of the porphyrins obtained were confirmed by ^{1}H NMR spectra. In this case the values of chemical shifts of the H$^\beta$-pyrrole protons were the most diagnostic signals. It was easy to

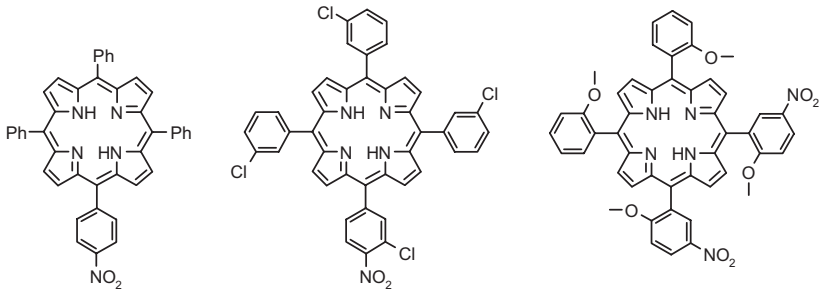

Figure 1.

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assign correctly the structures due to different symmetry of the 5,10-bis(4-nitroaryl)porphyrin derivatives vs. their 5,15-bis(4-nitroaryl)-isomers.

The latter is more trivial problem and the compounds should give two doublets for protons of pyrrole rings. Instead, in the first case, the spectral pattern in the region 8.75–9.05 ppm, due to different symmetry of the compounds, is more complicated and appears as the singlet–doublet–doublet–singlet system ($4 \times 2H$) with the coupling in the doublets $J \sim 5$ Hz, typical for pyrrole ring. This was a case in all investigated structures of the products obtained herein. Thus, it confirmed the correct assignments in the porphyrin skeleton.

The examples presented in this article demonstrate the general character of selective nitration in two neighboring aromatic rings of *meso*-tetraarylporphyrins. Taking into account a wide range of synthetic possibilities offered by the conversion of the NO_2 group (reduction to NO and NH_2, further functionalization via diazotization, substitution of hydrogen in position *ortho*-,[9] many types of cyclizations,[10] etc.) the presented method probably can receive much attention in the area of porphyrin skeleton modifications.

EXPERIMENTAL SECTION

^{1}H NMR spectra were recorded with a Varian GEMINI-200 spectrometer operating at 200 MHz. Coupling constants J are expressed in hertz [Hz]. Mass spectra were measured with an AMD 604 (AMD Intectra GmbH, Germany) spectrometer (electron impact and LSIMS methods) and MARINER (ESI-TOF) PerSeptive Biosystems spectrometer (ESI method); m/z intensity values for peaks are given as a % of relative intensity. UV–Vis spectra were measured with Beckman DU-68 spectrometer. TLC analysis was performed on aluminum foil plates precoated with silica gel (60F 254, Merck). Silica gel, 200–300 mesh (Merck AG), was used for column chromatography.

All of the *meso*-tetraarylporphyrins used were prepared from pyrrole and the corresponding benzaldehyde derivatives by the method described earlier in the literature for TPP[8]: **1a**, 48%; **1b**, 53%; **1c**, 74%; **1d**, 45%; **1e**, ca 39%. Product **1e** despite several attempts, could not be separated from the contaminations via chromatography, ca 90% purity; this compound, as such, was used in the nitration with HNO_3.

Data for porphyrins **1a** and **1b** - see literature.[4] Data obtained for porphyrins **1c–e** are similar to that described previously.[11–13]

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***meso*-Tetrakis(3-chlorophenyl)porphyrin (1c).**[11] M.p.: >300°C. ^{1}H NMR ($CDCl_3$, 200 MHz): 8.86 (s, 8H, H^β-pyrrole), 8.22 (s, 4H, H-2 of Ar-Cl), 8.10 (apparent d, $J = 7.3$ Hz, 4H, H-4 of Ar-Cl), 7.84–7.65 (m, 8H, H-5 and H-6 of Ar-Cl), −2.88 (s, 2H, 2 × NH). UV–Vis ($CHCl_3$), λ_{max} (lgε): 644.5 (3.60), 589 (3.91), 548 (3.93), 515 (4.38), 418 nm (5.67, Soret). MS (EI), *m*/*z* (% rel. int.): 758 (3), 757 (7), 756 (13), 755 (19), 754 (47), 753 (47), 752 (84), 751 (35), and 750 (66) [isotopic $M^{+\cdot}$], 719 (9), 717 (14), 716 (11), 715 (13), 680 (3), 679 (3), 678 (4), 641 (6), 639 (6), 604 (9), 569 (5), 567 (5), 502 (10), 500 (10), [379 (7), 378 (15), 377 (13), 376 (13), 375 (7)-isotopic doubly charged ions M^{2+}], 340 (11), 305 (15), 190 (23), 89 (40), 77 (86), 44 (100). HR-MS (ESI) calcd. for $C_{44}H_{27}N_4Cl_4$ (M + H): 751.0990, Found: 751.0971.

***meso*-Tetrakis(3-methoxyphenyl)porphyrin (1d).**[12] M.p.: >300°C. ^{1}H NMR ($CDCl_3$, 200 MHz): 8.88 (s, 8H, H^β-pyrrole), 7.81 (d, $J = 7.4$ Hz, 4H, H-6 of Ar-OCH_3), 7.78 (d, $J = 2.4$ Hz, 4H, H-2 of Ar-OCH_3), 7.64 (apparent t, $J = 7.8$ Hz, 4H, H-5 of Ar-OCH_3), 7.33 (ddd, $J = 8.2$,2.3,1.0 Hz, 4H, H-4 of Ar-OCH_3), 3.98 (s, 12H, 4 × OCH_3), 2.81 (s, 2H, 2 × NH). UV–Vis ($CHCl_3$), λ_{max} (lgε): 643 (3.46), 589 (3.72), 550.5 (3.81), 515 (4.31), 419 nm (5.70, Soret). MS (EI), *m*/*z* (% rel. int.): 738 (1), 737 (4), 736 (17), 735 (55), and 734 (100) [isotopic $M^{+\cdot}$], 719 (4), 703 (3), 675 (2), 627 (3), 597 (2), 569 (2), [368 (9) and 367 (14)-isotopic doubly charged ions M^{2+}], 69 (21), 57 (29). MS (ESI), *m*/*z* (% rel. int.): 737 (7), 736 (44), and 735 (100) [isotopic M + H]. HR-MS (ESI) calcd. for $C_{48}H_{39}N_4O_4$ (M + H): 735.2971, Found: 735.2970.

***meso*-Tetrakis(2-methoxyphenyl)porphyrin (1e).**[12,13] Main product, contaminated with other compounds, ca 90% purity. ^{1}H NMR ($CDCl_3$, 200 MHz): 8.72 (s, 8H, H^β-pyrrole), 8.09–7.91, 7.81–7.70, and 7.39–7.27 (3 × m, 16H, H-Ar(OCH_3)), 3.61, 3.58, and 3.55 (3 lines, 12H, 4 × OCH_3), −2.62 (s, 2H, 2 × NH). UV–Vis ($CHCl_3$), λ_{max}: 643.5, 589.5, 548, 513.5, 417.5 nm (Soret); as the product was not pure, the lgε values are not given herein. MS (EI), *m*/*z* (% rel. int.): 735 (M + H, 44), 734 ($M^{+\cdot}$, 81), 703 (4), 673 (3), 596 (2), 492 (17), 491 (33), [368 (16) and 367 (37)-isotopic doubly charged ions M^{2+}], 201 (29), 200 (20), 121 (37), 77 (41), 44 (100). HR-MS (ESI) calcd. for $C_{48}H_{39}N_4O_4$ (M + H): 735.2971, Found: 735.2968.

Nitration of *meso*-Tetraarylporphyrins. General Procedure and Modifications.

TPP (**1a**; 50 mg, 0.08 mmole) was dissolved in dry $CHCl_3$ (15 mL), and the solution was stirred under argon and cooled to ca 2°C. To this

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mixture nitric acid (314 mg, 0.2 mL, $d = 1.53$) was added via syringe. After 2 h the next portion of HNO_3 (0.2 mL) was added, the reaction was continued for 1 h, and the mixture was allowed to warm to room temperature. Then, the next portion of HNO_3 (0.2 mL) was added and it was left for 20 h (overnight) at room temperature. The reaction mixture was washed with water (5×20 mL) and dried with $MgSO_4/Na_2CO_3$. The crude residue was chromatographed using a mixture of *n*-hexane/$CHCl_3$ as eluent (from 1:1 to 1:4) to give: 5-(4-nitrophenyl)-10,15,20-triphenylporphyrin (**3**)[4] (3 mg, 6%) and 5,10-*bis*(4-nitrophenyl)-15,20-diphenylporphyrin (**2a**) (24 mg, 42%).

For 5,10,15,20-tetra(*meta*-tolyl)porphyrin (**1b**, 50 mg), 200 mg (0.13 mL) of HNO_3 was used at 0–2°C and after 2 h–314 mg (0.2 mL); then it was permitted to stir while equilibrating to room temperature (ca 0.5 h; TLC monitoring of the reaction). Chromatography was performed using a gradient mixture of *n*-hexane/$CHCl_3$ (from 2:1 to 1:2, then with $CHCl_3$); yield of 5,10-bis(3-methyl-4-nitrophenyl)-15,20–bis(3-methylphenyl) porphyrin (**2b**) - 47 mg (83%).

For 5,10,15,20-tetrakis(3-chlorophenyl)porphyrin (**1c**) 1.5 g of HNO_3 (ca 1.0 mL) was added to 51 mg of **1c** at room temperature and stirred for 4 min. Then, $CHCl_3$ (10 mL) was added and it was poured onto ice water (30 mL). After separation, the organic layer was washed with water (5×10 mL). After drying over $MgSO_4/Na_2CO_3$ it was chromatographed ($CHCl_3$/*n*-hexane; from 1:1 to 4:1, then with $CHCl_3$) to give the starting 5,10,15,20-tetrakis(3-chlorophenyl)porphyrin **1c**: 6 mg (12%); 5-(3-chloro-4-nitrophenyl)-10,15,20-tris(3-chlorophenyl)porphyrin (**4**): 12 mg (22%); and 5,10-bis(3-chloro-4-nitrophenyl)-15,20-bis(3-chlorophenyl)-porphyrin (**2c**): 15 mg (26%; 30% for recovered **1c**).

For 5,10,15,20-tetrakis(3-methoxyphenyl)porphyrin (**1d**) and 5,10,15,20-(2-methoxyphenyl)porphyrin (**1e**) [48 mg, 0.065 mmole] 150 mg (0.10 mL) of HNO_3 was used at 0–2°C and the mixture was stirred at this temperature for 1 h. Then, the next portion of HNO_3 (150 mg, 0.10 mL) was added and the reaction was continued for 10 min to 1 h (TLC monitoring). After work-up, the crude mixture was chromatographed on preparative TLC (eluent: $CHCl_3$/*n*-hexane–1:1) to give respectively:
5,10-bis(3-methoxy-4-nitrophenyl)-15,20-bis(3-methoxyphenyl)porphyrin (**2d**); 20 mg (37%) – from **1d**.

or a mixture of bis-nitrated porphyrins in which compound **5** was the major product; 21 mg (39%) – from **1e**.

5-(4-Nitrophenyl)-10,15,20-triphenylporphyrin (3). For data – see literature[4]; all spectral data in our hands were in agreement with those described in Ref.[4]

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5,10-Bis(4-nitrophenyl)-15,20-diphenylporphyrin (2a). M.p.: >300°C. ^{1}H NMR ($CDCl_3$, 200 MHz): 8.92 (d, $J = 4.9$ Hz, 2H, H^{β}-pyrrole), 8.89 (s, 2H, H^{β}-pyrrole), 8.79 (s, 2H, H^{β}-pyrrole), 8.75 (d, $J = 4.9$ Hz, 2H, H^{β}-pyrrole), 8.62 and 8.38 (AA′XX′, 8H, H-Ar(NO_2)), 8.26–8.18 (m, 4H, H-Ar), 7.84–7.72 (m, 6H, H-Ar), −2.77 (s, 2H, 2 × NH). UV–Vis ($CHCl_3$), λ_{max} (lgε): 646 (3.60), 591 (3.82), 553 (3.99), 517 (4.30), 420.5 nm (5.48, Soret). MS (EI), *m*/*z* (% rel. int.): 707 (3), 706 (8), 705 (37), and 704 (72) [isotopic $M^{+\cdot}$], 675 (5), 674 (12), 659 (7), 658 (7), 644 (8), 612 (5), 536 (4), 535 (4), 505 (2), 429 (4), 352 (6, doubly charged ion M^{2+}), 281 (16), 207 (45), 77 (50), 57 (31), 55 (33), 44 (100). HR-MS (ESI) calcd. for $C_{44}H_{29}N_6O_4$ (M + H): 705.2250, Found: 705.2220.

5,10-Bis(3-methyl-4-nitrophenyl)-15,20-bis(3-methylphenyl)porphyrin (2b). M.p.: >300°C. ^{1}H NMR ($CDCl_3$, 200 MHz): 9.03 (d, $J = 4.7$ Hz, 2H, H^{β}-pyrrole), 9.00 (s, 2H, H^{β}-pyrrole), 8.93 (s, 2H, H^{β}-pyrrole), 8.89 (d, $J = 4.7$ Hz, 2H, H^{β}-pyrrole), 8.40 (part of AB, $J = 8.8$ Hz, 2H, H-Ar(NO_2)), 8.30–8.18 (m, 4H), 8.09–8.00 (m, 4H), and 7.72–7.58 (m, 4H) [H-Ar], 2.91 (s, 6H, 2 × CH_3), 2.66 (s, 6H, 2 × CH_3), NH-undetected. UV–Vis ($CHCl_3$), λ_{max} (lgε): 645.5 (3.71), 590.5 (3.92), 552 (4.08), 516 (4.41), 421 nm (5.66, Soret). MS (EI), *m*/*z* (% rel. int.): 762 (6), 761 (10), and 760 (16) [isotopic $M^{+\cdot}$], 714 (2), 668 (2), 640 (2), 281 (7), 248 (9), 246 (10), 207 (43), 91 (36), 57 (75), 44 (100). MS (ESI), *m*/*z* (% rel. int.): 763 (19) and 762 (61) [isotopic M^+ and M + H], 761 (M + H, 100). HR-MS (ESI) calcd. for $C_{48}H_{37}N_6O_4$ (M + H): 761.2876, Found: 761.2991. Calcd. for $C_{48}H_{36}N_6O_4$ (760.85): C, 75.77; H, 4.77; N, 11.05. Found: C, 76.23; H, 4.70; N, 10.11.

5,10-Bis(3-chloro-4-nitrophenyl)-15,20-bis(3-chlorophenyl)porphyrin (2c). M.p.: >300°C. ^{1}H NMR ($CDCl_3$, 200 MHz): 8.93 (d, $J = 4.9$ Hz, 2H, H^{β}-pyrrole), 8.89 (s, 2H, H^{β}-pyrrole), 8.86 (s, 2H, H^{β}-pyrrole), 8.82 (d, $J = 4.9$ Hz, 2H, H^{β}-pyrrole), 8.43 (d, $J = 1.4$ Hz, 2H, H-Ar(Cl)(NO_2)), 8.32 (part of AB, $J = 8.4$ Hz, 2H, H-Ar(Cl)(NO_2)), 8.27 (part of AB coupled with another proton, $J = 8.4, 1.4$ Hz, 2H, H-Ar(Cl)(NO_2)), 8.23–8.06 (m, 4H, H-Ar), 7.87–7.67 (m, 4H, H-Ar), −2.90 (broad s, 2H, 2 × NH). UV–Vis ($CHCl_3$), λ_{max} (lgε): 646 (3.50), 590.5 (3.89), 549.5 (3.93), 515 (4.38), 420.5 nm (5.60, Soret). MS (EI), *m*/*z* (% rel. int.): 848 (1), 847 (2), 846 (5), 845 (7), 844 (15), 843 (11), 842 (22), 841 (9), and 840 (17) [isotopic $M^{+\cdot}$], 796 (4), 795 (3), 794 (3), 759 (3), 714 (4), 305 (5), 304 (5), 107 (42), 89 (47), 77 (100), 44 (69). LSIMS (+): *m*/*z* (% rel. int.): 846 (<1), 845 (3), 844 (2), 843 (5), 842 (3), and 841 (3) [isotopic M + H]. HR-MS (ESI) calcd. for $C_{44}H_{25}N_6O_4Cl_4$ (M + H): 841.0691, Found: 841.0635. Calcd. for $C_{44}H_{24}N_6O_4Cl_4$ (842.52): C, 62.73; H, 2.87; N, 9.97. Found: C, 62.53; H, 2.88; N, 9.38.

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5,10-Bis(3-methoxy-4-nitrophenyl)-15,20-bis(3-methoxyphenyl)porphyrin (2d). M.p.: >300°C. ^{1}H NMR ($CDCl_3$, 200 MHz): 8.96 (d, $J = 5.0$ Hz, 2 H, H^β-pyrrole), 8.92 (s, 2H, H^β-pyrrole), 8.89 (s, 2 H, H^β-pyrrole), 8.83 (d, $J = 5.0$ Hz, 2H, H^β-pyrrole), 8.26 (d, $J = 8.2$ Hz, 2H, H-5 of $Ar(OCH_3)(NO_2)$), 7.96 (d, $J = 1.2$ Hz, 2H, H-2 of $Ar(OCH_3)(NO_2)$), 7.90 (dd, $J = 8.2,1.4$ Hz, 2H, H-6 of $Ar(OCH_3)(NO_2)$), 7.81 (d, $J = 7.7$ Hz, 2H, H-6 of Ar-OCH_3), 7.78 (s, 2H, H-2 of Ar-OCH_3), 7.67 (apparent t, $J = 7.6$ Hz, 2H, H-5 of Ar-OCH_3), 7.48–7.31 (m, 2H, H-4 of Ar-OCH_3), 4.07 (s, 6H, $2 \times OCH_3$), 4.00 (s, 6H, $2 \times OCH_3$), −2.74 and −2.83 ($2 \times$ s, 2 H, $2 \times$ NH). UV–Vis ($CHCl_3$), λ_{max} (lgε): 647.5 (3.58), 592 (3.85), 556 (3.97), 516 (4.24), 421 nm (5.52, Soret). MS (EI), *m*/*z* (% rel. int.): 827 (2), 826 (5), 825 (16), 824 (32) [isotopic $M^{+\cdot}$ and M + H], 794 (3), 778 (4), 777 (3), 731 (2), 701 (2), 672 (1), 412 (2, doubly charged ion M^{2+}), 355 (3), 341 (2), 281 (14), 207 (17), 44 (100). MS (ESI), *m*/*z* (% rel. int.): 827 (12), 826 (48), 825 (100), 824 (32) [isotopic M^+ and M + H]. HR-MS (ESI) calcd. for $C_{48}H_{37}N_6O_8$ (M + H): 825.2673, Found: 825.2546. Calcd. for $C_{48}H_{36}N_6O_8$ (824.85): C, 69.89; H, 4.40; N, 10.19. Found: C, 70.18; H, 4.16; N, 9.74.

5-(3-Chloro-4-nitrophenyl)-10,15,20-tris(3-chlorophenyl)porphyrin (4). M.p.: >300°C. ^{1}H NMR ($CDCl_3$, 200 MHz): 8.92 (d, $J = 4.9$ Hz, 2H, H^β-pyrrole), 8.88 (s, 4H, H^β-pyrrole), 8.81 (d, $J = 4.9$ Hz, 2H, H^β-pyrrole), 8.44 (s, 1H, H-Ar(Cl)(NO_2)), 8.30 and 8.26 (AB system, $J = 7.7$ Hz, 2H, H-Ar(Cl)(NO_2)), 8.23 (s, 3H, H-Ar), 8.11 (d, $J = 7.3$ Hz, 3H, H-Ar(Cl)), 7.86–7.66 (m, 6H, H-Ar(Cl)), −2.88 (s, 2H, $2 \times$ NH). UV–Vis ($CHCl_3$), λ_{max} (lgε): 645 (3.69), 589.5 (4.06), 550 (4.13), 515 (4.58), 419.5 nm (5.71, Soret). MS (EI), *m*/*z* (% rel. int.): 803 (3), 802 (2), 801 (4), 800 (7), 799 (12), 798 (11), 797 (19), 796 (10), and 795 (15) [isotopic $M^{+\cdot}$], 752 (4), 751 (3), 749 (3), 716 (4), 714 (2), 107 (34), 89 (48), 77 (100), 44 (85). LSIMS (+), *m*/*z* (% rel. int.): 803 (3), 802 (6), 801 (7), 800 (19), 799 (24), 798 (28), 797 (30), 796 (28), and 795 (17) [isotopic M^+ and M + H]; HR-LSIMS calcd. for $C_{44}H_{25}N_5O_2Cl_4$ (M^+): 795.0762, Found: 795.0804. Calcd. for $C_{44}H_{25}N_5O_2Cl_4$ (797.53): C, 66.27; H, 3.16; N, 8.78. Found: C, 66.51; H, 3.17; N, 8.34.

5,10-Bis(2-methoxy-5-nitrophenyl)-15,20-bis(2-methoxyphenyl)porphyrin (5). In this case we postulated the structure **5** of the dinitro product (see Fig.1) as the most probable structure due to steric and electronic demands; the spontaneous decomposition of the product at all stages of the synthesis and work-up was observed.

For contaminated product, ^{1}H NMR, UV–Vis, and MS spectra were recorded; the molecular mass was determined by LSIMS (+) method. ^{1}H NMR ($CDCl_3$, 200 MHz; main isomer): 8.82–8.58 (m, 8 H, H^β-pyrrole), 8.26–7.70 (m, 6H, H-Ar), 7.46–7.28 (m, 8H, H-Ar), 3.70 (s,

6H, $2 \times OCH_3$), 3.59 (s, 6H, $2 \times OCH_3$). −2.66 (s, 2H, $2 \times NH$). UV–Vis ($CHCl_3$), λ_{max} (lgε): 642, 589, 549, 513, 420 nm (Soret); as the product was not pure, the lgε values are not given herein. MS (EI), *m*/*z* (% rel. int.): 827 (1), 826 (3), 825 (5), and 824 (9) [isotopic M^+], 794 (1), 614 (4). LSIMS (+): 825 (8%, M + H). HR-LSIMS calcd. for $C_{48}H_{37}N_6O_8$ (M + H): 825.2673, Found: 825.2704.

REFERENCES

1. (a) Sternberg, E.D.; Dolphin, D.; Brückner, Ch. Tetrahedron **1998**, *54*, 4151; (b) Hsi, R.A.; Rosenthal, D.I.; Glatstein, E. Drugs **1999**, *57*, 725.
2. (a) Bartoli, G. Acc. Chem. Res. **1984**, *17*, 109; (b) Behnisch, R. In *Methoden der Organischen Chemie*, Houben-Weyl; Georg Thieme Verlag: Stuttgart–New York, 1992; Band E16d, Teil I, pp. 389–405.
3. (a) Catalano, M.M.; Crossley, M.J.; Harding, M.M.; King, L.G. J. Chem. Soc., Chem. Commun. **1984**, 1535; (b) Evans, B.; Smith, K.M.; Cavaleiro, J.A.S. J. Chem. Soc., Perkin Trans. 1 **1978**, 768; (c) Crossley, M.J.; King, L.G. J. Org. Chem. **1993**, *58*, 4370; (d) Crossley, M.J.; Harding, M.M.; Tansey, Ch.W. J. Org. Chem. **1994**, *59*, 4433; (e) Shine, H.J.; Padilla, A.G.; Wu, S.-M. J. Org. Chem. **1979**, *44*, 4069.
4. Kruper, W.J., Jr.; Chamberlin, T.A.; Kochanny, M. J. Org. Chem. **1989**, *54*, 2753.
5. Rothemund, P.J. Am. Chem. Soc. **1936**, *58*, 625; **1939**, *61*, 2912.
6. Lindsey, J.S. In *The Porphyrin Handbook*; Kadish, K.M., Smith, K.M., Guilard, R., Eds.; Academic Press: San Diego, 2000; Vol. 1, 45–118.
7. (a) Tsuchida, E.; Hasegava, E.; Kanayama, T. Macromolecules **1978**, *11*, 947; (b) Thomas, D.W.; Martell, A.E. J. Am. Chem. Soc. **1956**, *78*, 1335; **1956**, *78*, 1338.
8. (a) Lindsey, J.S.; Hsu, H.C.; Schreiman, I.C. Tetrahedron Lett. **1986**, *27*, 4969; (b) Lindsey, J.S.; Schreiman, I.C.; Hsu, H.C.; Kearney, P.C.; Marguerettaz, A.M. J. Org. Chem. **1987**, *52*, 27.
9. (a) Ostrowski, S.; Shim, Y.K. Bull. Korean Chem. Soc. **2001**, *22*, 9; (b) Mąkosza, M.; Wojciechowski, K. Liebigs Ann./Recueil **1997**, 1805.
10. (a) Davies, R.B.; Pizzini, L.C. J. Org. Chem. **1960**, *25*, 1884; (b) Kimura, M.; Obi, N.; Kawazoi, M. Chem. Pharm. Bull. **1972**, *20*, 452; (c) Danikiewicz, W.; Mąkosza, M. J. Chem. Soc., Chem. Commun. **1985**, 1792; (d) Wróbel, Z.; Mąkosza, M. Tetrahedron **1997**, *53*, 5501; (e) Wróbel, Z.; Mąkosza, M. Synlett **1993**, 597.

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11. Xiaoquan, L.; Zaixin, G.; Jingwan, K.; Zhihua, W.; Jinzhang, G. Synth. Commun. **2000**, *30*, 2213.
12. Semeikin, A.S.; Koifman, O.I.; Nikitina, G.Ye.; Berezin, B.D. Zh. Obshch. Khim. **1984**, *54*, 1599.
13. Onaka, M.; Shinoda, T.; Izumi, Y.; Nolen, E. Tetrahedron Lett. **1993**, *34*, 2625.

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