Sveučilište u Rijeci
University of Rijeka

BIOtech
Odjel za biotehnologiju
51000 Rijeka, Radmile Matejčić 2
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Detailed curriculum for the course:

Laboratory apprenticeship – Synthesis of photosensitisers for photodynamic therapy

Academic year: 2020/2021

Program: Biotechnology for the Life Sciences (1st year)

Course code: EBLS103

ECTS points: 12

Language of the course: English

Teaching hours: 280 hours (all practical work)

Pre-requisites: Successful completion of BLS103 "Introduction to Laboratory Work and Safety"

Course leader and contact information:

Title and name: Izv. prof. dr. sc. Nela Malatesti
Address: Odjel za biotehnologiju, O-208
E-mail: nela.malatesti@biotech.uniri.hr

Time period: 1st March - 16th April 2021

Teaching staff:

Course leader:
Izv. prof. dr. sc. Nela Malatesti

Associates:
Martina Mušković, mag.med.chem.

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Required reading:

1) Wainwright M (2008) Photodynamic Therapy: The Development of New Photosensitisers. *Anticancer. Agents Med. Chem*. 8:280–291.

2) Kiesslich T, Gollmer A, Maisch T, Berneburg M, Plaetzer K (2013) Comprehensive Tutorial on In Vitro Characterization of New Photosensitizers for Photodynamic Antitumor Therapy and Photodynamic Inactivation of Microorganisms. *Biomed Res Int* 2013: 840417.

Optional reading:

1) Ethirajan M, Chen Y, Joshi P, Pandey RK (2011) The role of porphyrin chemistry in tumor imaging and photodynamic therapy. *Chem Soc Rev* 40:340–62.
2) Huang Z (2005) A review of progress in clinical photodynamic therapy. *Technol Cancer Res Treat* 4:283–93.
3) Malatesti N, Munitic I, Jurak I (2017) Porphyrin-based cationic amphiphilic photosensitisers as potential anticancer, antimicrobial and immunosuppressive agents. *Biophys Rev* 9:149–168.
4) Montalti M, Credi A, Prodi L, Gandolfi MT (2006) *Handbook of Photochemistry*, 3rd edn. CRC Press, Boca Raton.
5) Pisarek S, Maximova K, Gryko D (2014) Strategies toward the synthesis of amphiphilic porphyrins. *Tetrahedron* 6685–6715.

Course description:

Photodynamic therapy is an approach in the treatment of cancer, developed almost entirely in the last decade, and which recently has been increasingly studied with regard to applications in the treatments of various pathogenic microbes. PDT involves a molecule, usually an organic dye, called a photosensitiser (PS) that, upon absorption of visible light, generates singlet oxygen and other cytotoxic species, which leads to cell damage and death. PDT is minimally invasive and highly selective because PS often accumulates preferentially in tumour cells. Additional selectivity is achieved by local light application to protect healthy cells and susceptible tissues.

Dr. Nela Malatesti and her research group are developing new photosensitisers based on pyridylporphyrin structure, for various anticancer and antimicrobial applications in PDT. Our aim is to obtain and study amphiphilic PSs with optimal photo-physicochemical properties required for highly effective PDT with no or minimal side-effects.

During this course, students will spend 8 weeks conducting laboratory work in Dr. Malatesti's research group. This will begin with basic training in the organic synthesis and spectroscopy techniques required. This teaching will occur in a "mentorship" situation, with two students being taught at a time. As the skills of the students develop, they will then begin to perform research experiments, using these techniques, to gain novel insight into the research field of porphyrin synthesis for applications in PDT.

After completion of the course, students will then have the option of continuing their research as a Research Project under the mentorship of Dr. Malatesti, or of instead performing their project in a different research group of choice.

Learning outcomes:

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Students will gain an in depth theoretical knowledge of the study of new potential photosensitisers for applications in photodynamic therapy (PDT) through organic synthesis and spectroscopic techniques. This will come through reading on the subject, discussion with the course leader/mentor and other members of the research group, as well as first-hand experience in the laboratory.

Practically, students will gain significant practical experience at methods of porphyrin synthesis, which will involve performing reactions under various conditions, following reactions and purifying the reaction mixtures by chromatography techniques. Isolated products (new photosensitisers) will be characterised and studied spectroscopically (UV/Vis, fluorescence, ^{1}H NMR, ^{13}C NMR, IR-ATR). Cytotoxicity of the photosensitisers will be evaluated by MTT test on tumour cells in vitro without light activation ("dark toxicity") and with light activation to test their photodynamic activity and potential for photodynamic therapy. This will be obtained through guided training, and reinforced through using the techniques to perform genuine research experiments. In this way, the skills learned should become relevant to the students in a research context.

Through work in a research environment, students will also have an opportunity to hone their soft research skills, including searching the academic literature, critical review of papers, experimental design and analysis, and writing of scientific reports.

Requirements, methods of assessment and evaluation:

Students will perform laboratory work within the research group of Dr. Malatesti, in areas of relevance to her research projects on synthesis of amphiphilic pyridylporphyrins for applications in photodynamic therapy.

This work will initially take the form of semi-structured exercises, during which the students will learn basic organic synthesis techniques. Later on, the students will use these techniques to conduct research experiments and various spectroscopy studies relevant to characterisation of the potential photosensitiser for PDT.

Students will be required to keep a laboratory note-book, in the English language, of their results. They will also be required to discuss their work and results at regular laboratory meetings.

Students will undertake extensive reading around the subject, initially through papers given to them, but with additional independent reading later on. They may also be required to present one of these papers as part of the course "Journal Club 1".

Students will receive continuous assessment from the mentor/course leader who will meet with and teach the students on a regular basis. In this way, the student will both be assessed, and received continuous feedback concerning their work. At the end of the course, the mentor will submit a report on their work and progress. The mentor's report, and accompanying grade, will account for 50% of the student's grade for the course.

Additionally, at the end of the course, the student will submit a short report (approximately 3 pages), detailing the area that they worked in, the experiments they performed, any results they obtained, and skills which they learned and used. This report will then be assessed by the mentor and one other member of faculty, who will together agree on a grade for the remaining 50% of the course.

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Qualification and grades (according to the *University of Rijeka Study Regulations*):

The following grades will be awarded based on the final score:

Percentage score	ECTS grade	Numerical grade
90% to 100%	A	Excellent (5)
75% to 89.9%	B	Very good (4)
60% to 74.9%	C	Good (3)
50% to 59.9%	D	Satisfactory (2)
0% to 49.9%	F	Unsatisfactory (1)

The final grade is based on the sum of percentage points accumulated during the course. Passing grades are excellent (5), very good (4), good (3) and satisfactory (2).

Schedule of classes:

Daily, from 8:00-17:00, including (lunch) break, every weekday, from 01.03.2021 to 16.04.2021 (excluding national and University holidays). All work will be performed in laboratories O-147 and O-148, unless otherwise indicated by the course leader/supervisor.

Additional information:
Academic integrity

Students are required to respect the principles of academic integrity, and refer to the documents: *Ethics Guidelines of the University of Rijeka* and the *Ethics Guidelines for Students*.