UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Molecular Biology Applied To The Production of Therapeutic Proteins

2627-1-F0803Q081

Aims

Knowledge and understanding:
At the end of the course, students will gain knowledge of the topics and advanced molecular and cellular biology techniques and their possible biotechnological applications.

Ability to apply knowledge and understanding:
At the end of the course, students will gain the ability to read and understand scientific papers dealing with innovative aspects of biotechnology and to develop applications based on this knowledge.

Making judgements
At the end of the course, students will be able to process what they have learned and to recognize the contexts of application of the advanced molecular and cellular biology techniques of the course.

Communication skills
At the end of the course, students will be able to express themselves appropriately, using a proper vocabulary in the description of the treated topics.

Learning skills
At the end of the course, students will be able to read and understand the literature on the treated topics.

Contents

The course aims to provide a global and reasoned view of the main classic and advanced techniques used for the expression of recombinant proteins, e.g. hormones, growth factors, and new-generation vaccine production, besides DNA and RNA vaccines.

Transient and stable expression systems will be treated in different hosts such as vegetables and microorganisms useful for both basic research and molecular farming.

Detailed program

Bacteriophages and recombinant bacteria as production platforms, vaccines, or for drug delivery.
Use of yeast for the production of molecules for pharmaceutical use: vaccines, antibodies, hormones, therapeutic enzymes, growth factors. Vaccines based on surface display in yeast and yeast-derived VLPs.
Expression in higher eukaryotes. Transfection of mammalian cells. Viral and retroviral vectors. Recombinant proteins in mammalian cell cultures.
Biomolecular technologies based on the use of plant organisms. Stable or transient transformation of plant species. Methods of biolistic transformation, protoplast transformation, microinjection, bioactive beads. Systems mediated by Agrobacterium tumefaciens; agroinfiltration, agrodrenching. Ti plasmid characteristics and T-DNA transfer mechanism. Engineering of vectors for A. tumefaciens-mediated genetic transformation. Expression vectors for application and basic studies. Marker genes and obtaining marker-free plants. Regulatory sequences of promoters, introns, and leader sequences; transgenesis and cisgenesis in plants to improve the expression of heterologous molecules. Expression and production of vaccines in plants.
Plant viruses as expression systems. The main viral vectors: RNA viruses (Tobacco mosaic virus, Potato virus); DNA viruses (Cauliflower mosaic virus, Geminivirus). Expression of immunogenic proteins, polypeptides, and epitopes by viruses that form Virus Like Particles (VLP).
Biotechnological vaccines and their design. Some examples of biotechnological vaccines: anti-hepatitis B, anti-HPV, anti-Rotavirus, and conjugated polysaccharide vaccines. Rational design of DNA and RNA vaccines.

Prerequisites

Backgrounds. Basics of Molecular Biology.
Prerequisites: none.

Teaching form

14 Traditional Lectures based on delivered didactics (Didattica erogativa, DE) focused on the presentation of concepts by the lecturer.
7 Lectures based on Interactive teaching (Didattica Interattiva, DI) consisting in search and analysis of scientific papers and subsequent oral presentations by a small group of students for a case study.
Lectures are in presence unless for straordinary condition
Teaching laguage: italian or english (in case non italian students are enrolled in this course)

Textbook and teaching resource

Slides and a selection of scientific papers. Records of the lectures in delivered didactics will be available at the e-learning platform of the course. The teaching material will be in English.

Semester

First semester

Assessment method

The exam consists of an **oral interview** divided into two parts:

- Case study discussion: Presentation and critical analysis, chosen by the student, of an in-depth topic not covered in class, focusing on a pathology and the related biotechnological/biological drugs used as therapy.
- Verification of course content: Questions on the theoretical and practical topics covered during lectures.

Evaluated Competences. The exam aims to verify the level of acquisition of the following competences:

- Cognitive: Mastery of advanced technical-scientific knowledge in the field of molecular biology.
- Methodological: Ability to analyze and critically evaluate the relevant scientific literature.

Grading Criteria. The final grade will be based on the weighting of the following criteria:

- 50% Scientific Depth and Accuracy: Rigor and precision in describing the molecular mechanisms of the pathology and the mechanism of action of biological drugs.
- 30% Critical Analysis Skills: Ability to independently discuss the limitations of the described therapy, experimental data, and potential side effects or off-target effects.
- 10% Language Proficiency: Correct, precise, and rigorous use of the specialized vocabulary of molecular biology and biotechnology.
- 10% Quality of Presentation: Clarity of exposition, logical flow of the argument, and time management during the presentation of the case study.

Office hours

On demand by email to the lecturer.

Sustainable Development Goals

GOOD HEALTH AND WELL-BEING | QUALITY EDUCATION