

Medical Biotechnology M.Sc.
Protein biotechnology
Weekly plan

Week 1: Biochemical properties of proteins. Protein synthesis. Review of the differences between procaryotic and eucaryotic protein synthesis.

Week 2: Protein folding, the formation of 3D structure. Chaperons. Folding problems and folding diseases.

Week 3: Protein sorting and targeting.

Week 4: Study of protein structures: X-ray crystallography, NMR, mass spectrometry.

Week 5: Protein purification (chromatography, electrophoresis) and analysis (SDS-PAGE, 2 dimensional electrophoresis, mass spectrometry).

Week 6: Posttranslational modification of proteins and their analysis using proteomics methods.

Week 7: Protein-protein interactions and their analysis: yeast two hybrid system, mass spectrometry, Biacore and other techniques.

Weeks 8: Heterologue expression I: Homologue and heterologue expression, biopharming; expression systems, criteria to the selection of expression platforms, heterologue expression in *Escherichia coli*, formation of inclusion body, periplasmic secretion, formation of disulfide bonds.

Week 9: Heterologue expression II: The disadvantages of the *Escherichia coli* system, development of new expression platforms; protein expression in gram-positive bacteria; the *Staphylococcus carnosus* expression system; Protein expression in yeasts; the *Saccharomyces cerevisiae* and the *Pichia pastoris* expression platforms.

Week 10: Heterologue expression III: The disadvantages of the microbial protein expression; heterologue expression in plant cell cultures, transformation with *Agrobacteria*, expression in mammalian cell, functionalized cells; heterologue expression in insect cell lines, the baculovirus-insect cell expression system.

Week 11: Definition of protein engineering; *de novo* design, artificial growing factors; rational design, site-directed mutagenesis; directed evolution, random mutagenesis, DNA shuffling, exon shuffling.

Week 12: Production of human therapeutic proteins. Biopharmaceuticals, production of human therapeutic proteins; production of insulin, protein engineering of insulin; development of recombinant Hepatitis B vaccine; production of monoclonal antibodies; problems with the storage, *in vivo* stability and administration of therapeutic proteins.

Week 13: Production of human therapeutic enzymes: Enzymes in human therapy; production, and human therapeutically application of deoxyribonuclease I, β -glucocerebrosidase, urate oxidase and L-asparaginase, mechanism of action.

Week 14: Production of diagnostic enzymes. Importance of enzymes in diagnosis, production and application of glucose oxidase, galactose oxidase, cholesterol oxidase and horseradish peroxidase; protein engineering of enzymes.

Week 15: The application of therapeutic proteins. Possible administration, perspectives and future possibilities. The national and international requirements for protein therapeutic products.