

Educational institution "Polesky State University"

APPROVE

Rector "Polesky State University"

_____ K.K. Shebeko



Programme of exam

1-31 81 11 Applied Biotechnology

Master of Science.

Applied Biotechnology

The basic operations in industrial fermentations. Fermentors. The aerated stirred tank batch fermentor. Requirements for fermentation processes: aeration and agitation, temperature control, foam production and control, pH measurement and control, carbon dioxide measurement, oxygen determination, pressure control. Anaerobic batch fermentors. Continuous fermentations. Hemostats and turbidostats. Solid phase fermentation. Obtaining the desired products under various conditions of fermentation. Principle of scaling of technological processes: laboratory, pilot and industrial installations. The final stages of obtaining products of biotechnological processes. Division of biomass: flotation, filtration and centrifugation.

Cell cultivation. Cultures of plants, animals and humans. Cultivation of plant cells. Cell cycle and growth cycle. Methods of creating plant cell cultures. Callus and suspension cultures of cells of higher plants, methods of their preparation and field of application. Protoplasts of plant cells, their production, methods of regeneration and cultivation. Protoplast fusion of plant cells.

Cultivation of cells and tissues of animals. Methods of cultivation in suspension culture and in the adherent state. Requirements for the quality and composition of nutrient media. Primary and transplantable cultures. Reception and use of transgenic plants for increase of production of an agriculture and quality of a foodstuff.

Transgenic organisms. Production of transgenic animals for production of medical proteins. Possible risks of using genetically modified organisms (GMOs) for human health and the environment.

Microbiology

Features of the morphology of procaryotes. Surface structures of the bacterial cell: capsule, mucous membranes and villi. Cell wall: structure, chemical composition and functions, Gram staining. Types of plasmids and their role. Cytoplasm of procaryotes and intracytoplasmic inclusions: structure and their functions. Genetic apparatus of procaryotes.

Microbial physiology. The concept of growth and reproduction. The main parameters of microbial growth: the time of generation of procaryotes, the rate of growth and the yield of biomass. Factors affecting microbial growth: temperature, oxygen, carbon dioxide, osmotic pressure and pH. The kinetics of microbial growth. Batch culture and continuous culture.

Bacteria and human disease. Water-borne transmission: cholera. Air-borne transmission: "strep" throat. Contact transmission: syphilis. Vector-borne-transmission: plague. The concept of sterilization, aseptic, antiseptic, disinfection. Pasteurization. Immunity. Factors and mechanisms of natural stability.

Energy-yielding metabolism. Enzymes: the classification of enzymes, their role in the life of microorganisms, the characteristics of enzymatic reactions. The regulation of enzymatic activity in bacteria. The Jacob-Monod model of the negative control of protein synthesis. Catabolite regulation. Principles of energy generation. Oxidative phosphorylation and the electron transport chain.

Glucose metabolism. The Embden-Meyerhof-Parnas (EMP) pathway. The pentose phosphate (PP) pathway. The Entner-Duodoroff (ED) pathway. The phosphoketolase pathway. Bacterial photosynthesis and its difference from photosynthesis of plants. Types of fermentation. Alcoholic, butyric, propionic acid, lactic acid (homofermentative and heterofermentative) and acetic fermentation. Anaerobic respiration utilizing (SO_4^{2-}) as terminal electron acceptor. Anaerobic respiration utilizing acceptor (NO_3^-) as terminal electron acceptor. Anaerobic respiration utilizing fumarate as terminal electron acceptor. Nitrogen fixation carried out by nitrogen fixing bacteria, the role of Azotobacter in this process.

Microbial diversity. General feature of the Archaea. Proteobacteria. Iron- and sulphur-oxidising Proteobacteria. The Pseudomonads. Predatory Proteobacteria. Enteric Proteobacteria. Photosynthetic Proteobacteria: the purple sulphur and purple non-sulphur bacteria. Nitrifying Proteobacteria.

Phylum Cyanobacteria. Phylum Chlamydiae. Phylum Spirochaetes. Phylum Chlorobi (green sulphur bacteria) and phylum Chloroflexi (green non-sulphur bacteria). The Gram-positive bacteria: phylum Firmicutes. Phylum Actinobacteria.

Methods of work with DNA

Genom structure. Genetic markers and their functional features. Organization of work of the PCR laboratory. DNA isolation. Preparation of samples for DNA isolation. Electrophoretic and spectrophotometric determination of DNA concentration. Dilution and storage of DNA samples. Molecular basis of PCR. Types of PCR analysis own their features. Components of the PCR reaction, their concentration and dilution. Parameters of PCR. The main advantages of PCR. Molecular bases of electrophoresis of nucleic acids. Visualization of PCR products by horizontal and vertical electrophoresis. Characterization of DNA analysis methods based on PCR. Practical use of PCR diagnostics. Sequencing and its types:

1. Maxam-Gillbert sequencing;
2. Sanger sequencing (chain-termination method);
3. High-throughput methods.

Plant physiology.

Photosynthesis. Pigments of photosynthesis. Chlorophylls. Chemical and physical properties of chlorophyll. Pigments of photosynthesis. Carotenoids. Ficobylines. Photophysical stage of photosynthesis. Photochemical stage. Cyclic and noncyclic electron flow. Photosynthetic phosphorylation. The light-independent reactions. C3 - pathway of photosynthesis (the Calvin cycle). C4-pathway of photosynthesis

(Hatch-Slack cycle). Effect of conditions on the intensity of the process of photosynthesis.

Features of growth and development of plants. The physiological role of elements of mineral nutrition. Elements needed for a plant organism. Macroelements in the plant body. Microelements in the plant body. Features of salt intake in the root system. Mechanism and ways of mineral salts entering through the root system. The role of roots in the life of plants. The influence of external and internal conditions on the flow of salts.

Features of the assimilation of molecular nitrogen in the plant. Chemical fixation of atmospheric nitrogen. Nutrition of plants. Nitrogen exchange of plants. Insectivorous plants. Parasites and semiparasites. Mycotrophic type of nutrition. Growth, differentiation and development of plants. Seed development and germination. Types of growth of plant organs. Differentiation of tissues. Kinetics of growth processes. Hormones, the hormone concept in plants. Auxins. Gibberellins. Cytokinins. Abscisic acid. Ethylene. Brassins (brassinosteroids). Interaction of phytohormones. The use of phytohormones in the practice of plant growing. Photomorphogenesis: responding to light. Photoperiodism. The circadian clock. Tropism (phototropism and gravitropism) and nastic movements: orienting plants in space.

Physiological basis of rest of plants. Peace of seeds and buds. Regulation of resting processes.

Literature

1. Brock Biology of microorganisms, 14th edition. M.T. Madigan, J.M. Martinko., K.S. Bender., D.H. Buckely., D.A. Stahl., T. Brock. Pearson., 2014., 1006 P.
2. Modern industrial Microbiology and Biotechnology. Nduka Okafor., Science Publishers., 2007., 530 P.
3. Essential Microbiology. Hogg S., Wiley., 2005., 468P.
4. Introduction to Plant Physiology., 4th edition. W.G. Hopkins., N.P.A. Huner., Wiley., 2009., 523P.
5. Plant Physiology, 3rd edition. L. Taiz., E. Zeiger. Sunderland: Sinauer Associates., 2003., 690 P.
6. Bowling, A.T. Likade mapping using equine half-sib families / A.T. Bowling, L.V. Millon, M.L. Eggeleston-Stott // Animal Genetics. – 1996. – V.27. – P.73.
7. Burton, D.W. Flow-cytometric analyses of nuclear DNA content in four families of neotropical bats / D.W. Burton, J.W. Bickham, H.H. Genoways // Evolution. – 1989. – Vol. 43, № 4. – P. 756–765.
8. DNA polymorphism amplified by arbitrary primers are useful as genetic markers / J.G.K. Williams [et al.] // Nucleic Acids Research. – 1990. – Vol. 18, № 22. – P. 6531–6535.

9. Grada A (2013) Next-generation sequencing : methodology and application. *J.Invest .Dermatol.*133(8): e11.
10. Hall N (2007) Advanced sequencing technology and their wider impact in microbiology. *J.Exp,Biol.*, 210,P.1518-1525.