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PROBLEMS OF TEACHING GENETICS AT A MEDICAL UNIVERSITY

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ABSTRACT

The most important area of human genetics for practical health care tasks is medical genetics. Sometimes it is considered not as a branch of human genetics, but as an independent field of general genetics. Medical genetics studies the distribution, etiology, pathogenesis, course of hereditary diseases, develops systems for diagnosis, treatment, prevention and rehabilitation of patients with hereditary diseases and medical examination of their families, and also studies the role and mechanisms of hereditary predisposition in human diseases. This article tries to summarize and concentrate the available literary material on microbial genetics and personal experience in teaching genetics, microbiology and immunology.

Geology has proven that the age of the Earth is 4.5-4.6 billion years. According to scientists, about 3.8 billion years ago, life became a major factor in the carbon cycle on the planet. The first organisms to appear were what modern science calls prokaryotes. These are single-celled creatures, compared to multicellular organisms, characterized by simplicity of structure and functions. These include bacteria and blue-green algae. The evolution of these micro-creatures is associated with the emergence of the mechanism of photosynthesis and organisms of the eukaryotic type [1].

Representatives of living nature can be conditionally divided into creatures belonging to the macro- and microworld. The macrocosm includes animals of all kinds: birds, insects, helminths, etc., the microcosm includes bacteria, viruses, Rickettsia, mycoplasma, fungi, protozoa, prions, nucleic acids (infectious DNA and RNA). Bacteria, fungi, and protozoa are single-celled representatives of the microcosm and the term “microorganisms” is applicable to them, since they are independent organisms capable of autonomous existence [2].

Viruses, prions, nucleic acids (infectious DNA and RNA) are not organisms in the full sense of the word due to the fact that they do not have organelles, do not have their own metabolism, and use the resources of animal, human, and plant cells for their life activity.

The unifying term for all forms of the microcosm is the term “microbes” [3].

Our planet is home to a huge number of microbes, calculated in astronomical numbers. In the course of their life activity, microbes have a significant impact on inanimate and living nature. It is known that bacteria ensure the circulation of substances and energy in nature, soil fertility, maintenance of gas composition, etc.

Many microbes are pathogenic for humans, animals, birds, insects, and plants [5].

The world of microbes is studied by microbiology - the science of microbes. It is divided into a number of departments and disciplines. As a result of the process of differentiation, the gradual separation of narrow areas of study and knowledge of microbes, the genetics of microorganisms was born - a science that studies their heredity and variability.

It should be noted that the curriculum for higher educational institutions in the specialty "Veterinary Medicine" pays little attention to the study of the genetics of microorganisms. Textbooks on microbiology and immunology, as well as textbooks on genetics, do not cover aspects of microbial genetics comprehensively and fully [4].

A microbial cell is a kind of biofactory that synthesizes a huge number of biologically active compounds. It produces more than 2500 proteins, enzymes, polysaccharides, lipids, vitamins and other substances. In this regard, in production conditions, actinomycetes and fungi are used to produce antibiotics, yeast - for feed protein, bacilli - for the synthesis of enzymes, clostridia - for fermenting sugars into acetone, ethanol, lactic acid bacteria - in the food industry, etc [6].

Strains have been selected from many pathogenic microorganisms for the production of vaccines, hyperimmune serums, immunoglobulins, and diagnostic drugs. Many microbes are used to obtain recombinant strains that produce hormones, interferons, and immunostimulants. Conscious, targeted and effective use of microbes for practical needs in veterinary medicine, medicine and other areas of human activity is unthinkable without knowledge of their genetics.

Along with this, many data from experimental genetics are significant for medicine directly from the point of view of developing methods for diagnosing, treating and preventing diseases, for example, in the mass diagnosis of a hereditary human metabolic defect - phenylketonuria, a genetic test on special strains of Bacillus subtilis is widely used [7]. The development of a wide range of modern antibiotics is possible only on the basis of an in-depth study of the private genetics of microorganisms that produce antibiotics and the use of genetic methods for their selection, and, more recently, genetic engineering methods for constructing microorganisms with desired properties. Methods of genetic engineering and biotechnology based on genetic approaches are also used in the production in vitro in industrial quantities of such drugs as human insulin, human interferon, and a number of other physiologically active substances.

Historically, modern medical genetics was preceded by what spread in the second half of the 19th century. and the first half of the 20th century. a social movement known as "eugenics," which combines theory and practical measures to "improve" the human race. Theoretically, eugenics was based on the real facts of hereditary conditioning of normal and pathological human characteristics, and in practice it was carried out in a number of countries (Hitler's Germany, etc.) as an inhumane recognition by law of certain categories of the population as socially inferior and condemned, therefore, to forced sterilization. At the same time, eugenicists unreasonably equated the hereditary cause of unfavorable traits with the inevitability and fatality of their development and extended ethically unacceptable principles of selection of agricultural plants and animals to the reproduction of humanity, trying to theoretically substantiate a kind of "human breeding" [8].

The methods used by genetics can be divided into two groups - genetic methods themselves and methods of related biological and medical disciplines, the use of which in genetics is determined by the hereditary characteristics being studied - biochemical, anatomical, physiological, mental, etc. The central place among the actual genetic methods is occupied by genetic analysis: a complex method designed to identify patterns of transmission from parents to offspring of certain traits and their manifestation in ontogenesis [9]. The main principle of genetic analysis is the quantitative accounting of the studied traits in groups of individuals related to each other by certain degrees of kinship. In experimental genetics this is achieved using systems of crossings and hybridological analysis, in medical genetics - using genealogical analysis.

Special types of genetic analysis include chromosome analysis, in which the study of the formation of structural and functional characteristics of organisms is combined with an analysis of the structure and behavior of individual chromosomes. In connection with the development of genetic engineering and biotechnology methods, the possibilities for analyzing genetic structures and processes at the molecular level have expanded significantly. Genetic analysis widely uses statistical (biometric) methods, without which it is impossible to reliably establish the nature of the transmission of hereditary information [10] .

In the process of development of genetics as a science, several stages can be distinguished. Until the end of the 19th century. in biology, various hypotheses were put forward about the nature of heredity and variability; The main prerequisites for the formation of scientific ideas about these phenomena were observational data on the essence of sexual reproduction in animals and plants, the results of experiments on plant hybridization and the development of the doctrine of the cell. The foundations of modern ideas about heredity and variability of organisms were first outlined by the Czech researcher G.J. Mendel in 1865. Mendel established the basic patterns of behavior of hereditary characteristics in hybrid offspring. He concluded that the formation of each hereditary trait is determined by a pair of material hereditary inclinations, one of which the body receives from the mother, the other from the father, and the specific implementation of the trait is determined by the relationship of dominance (predominance) - recessivity (suppression) between maternal and paternal inclinations; When germ cells mature, only one gene from each pair of genes enters each individual cell. The set of empirical and theoretical positions of Mendel was called "Mendelism". At the beginning of the 20th century. The experiments of botanists, zoologists and observations of doctors, carried out independently of each other, showed the universal significance of the principles of Mendelism for living nature and humans [11].

The most important step in the development of the genetics of Morgan herds was the construction by Th. H. Morgan and his colleagues in 1910-1915.chromosomal theory of heredity, according to which genes are located on chromosomes in a linear sequence and are reproduced during cell division, and paired chromosomes can exchange their sections (the phenomenon of crossing over), which leads to recombination of genetic material. The next step was to establish the chemical nature of chromosomal genes. Soviet geneticist N.K. Koltsov was one of the first to develop the idea of their macromolecular nature (1927) [12], and N.V.

Timofeev-Resovsky and co-authors in the mid-30s. 20th century calculated the approximate volume of the gene. In 1944, O.T. Avery and co-authors showed that the genetic material is DNA. In 1953, J.D. Watson and F.N.C. Crick proposed a model of the structure of DNA, the mechanism of its reproduction and mutation, and a little later created the theory of a universal genetic code (see Gene), with the help of which genetic information, encrypted in DNA, is implemented in the protein structure. These discoveries meant the transition of genetics to the molecular level of research.

At the very beginning of the 20th century. de Vries formulated the mutation theory, although the experimental production of mutations was not possible for a long time. For the first time in 1925, Soviet microbiologists G.A. Nadson and G.S. Filippov showed that after irradiation of yeast cells with ionizing radiation, various radio races arise, the properties of which are reproduced in the offspring. The genetics of microorganisms was the basis for the formation and development of one of the areas of biotechnology - genetic engineering. Genetic engineering involves designing cells with new genetic properties. In its essence, it comes down to genetic recombination, i.e., the production of new recombinant DNA molecules with given genetic information [13]. The process of obtaining recombinant DNA consists of several successive stages. The first stage comes down to isolating the DNA needed by the experimenter from the cells of the organism of interest. Then recombinant (hybrid) DNA is obtained by inserting a gene or group of genes encoding the required protein (hormone, enzyme, etc.) into the genome of the cell. after this, the recombinant DNA is introduced into a living cell (animal, plant, microbial), which is a kind of biofactory that synthesizes a large number of different compounds. Finally, a clone of cells possessing the desired characteristics is obtained, it is multiplied, conditions are created for maximum manifestation of the synthesizing ability of the cloned cells, and the required product is isolated.

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