1. DNA – hereditary molecule

The topic of today's lecture is the molecule of heredity - DNA - its chemical composition and structure. This lecture is part of Module 1: Animal Genetics, which is part of the ISAGREED project. This presentation was supported by an Erasmus+ KA2 - Partnerships for Cooperation grant: "Innovating the structure and content of curricula in the management of animal genetic and food resources using digitalization".

Deoxyribonucleic acid, abbreviated as DNA - referred to as genetic material, or otherwise as the inheritance molecule, is contained in every organism, which uses it to store genetic information and subsequently pass it on from parent to offspring generations.

- DNA is a macromolecule composed of two polynucleotide chains.
- These molecules carrying genetic information are localized in the cell nuclei of organisms.
- The nuclear DNA of an individual is universal to every cell of its organism.

DNA is a macromolecule composed of chains of monomeric nucleotides. Each nucleotide consists of three components. The first component is the nitrogenous base, which has a purine base such as adenine and guanine, or a pyrimidine base such as cytosine and thymine. Next, the pentose sugar 2-deoxyribose. The last component is a phosphate group. There is a beta-N-glycosyl bond between the nitrogenous base and 2-deoxyribose. Between 2-deoxyribose and the phosphate group is a phosphodiester bond.

Nucleosides are glycosylamines formed by attaching a nitrogenous base to a deoxyribose. The difference between a nucleotide and a nucleoside is the presence or absence of a phosphate group. In the case of a nucleotide, the phosphate group is present, unlike a nucleoside where the phosphate group is absent.

Important facts about DNA :

DNA has a double-stranded structure. This means that it consists of two single-stranded polynucleotide chains that are linked together by hydrogen bonds. The nucleotide building blocks of DNA are always paired in a complementary pattern. The adenine nucleotide binds with thymine and cytosine binds with guanine. The sequence in DNA is not random. The genetic information encoded in a DNA molecule is transmitted in a sequence of base pairs. In reality, genes are encoded in basic sequences.

DNA strands are antiparallel to each other. The fact that DNA is antiparallel means that the two strands of DNA have opposite chemical polarity. DNA arranged in strands is linear. A complete DNA molecule consists of two polynucleotide strands twisted in a right-handed double helix format. The spatial arrangement of bases is localized in the center of the molecule, and the remaining components, such as 2-deoxyribose and phosphates, form the outer skeleton of the secondary structure of DNA.

The mechanism of DNA replication is semiconservative. Replication results in two complete, double-stranded molecules, each consisting of one original strand of DNA serving as a template for the synthesis of the second strand. The process of self-replication proceeds by complementary nitrogenous base pairing. The process of replication proceeds based on complementary pairing of nitrogenous bases.

The DNA macromolecule is characterized by primary, secondary, and tertiary structure. The primary structure of DNA is determined by the order of nucleotides in the strand. The nucleotides are linked together by phosphodiester bonds to form a polynucleotide strand and thus a nucleic acid skeleton. The phosphate group links the fifth carbon of one pentose and the

third carbon of the next pentose to each other. The primary structure of the coding DNA determines the order of amino acids in proteins.

A DNA molecule consists of two polynucleotide chains linked together by hydrogen bonds, forming the basis for secondary structure. The secondary structure of DNA is a double right-handed helix, also called the α-helix. It is formed by two antiparallel strands of DNA. The antiparallel DNA strands pair due to intermolecular interactions in the form of hydrogen bonds. The nucleotide adenine binds to thymine via a double hydrogen bond, and cytosine binds to guanine via a triple hydrogen bond. The number of hydrogen bonds determines the strength of the bond, which is important for many events related to DNA metabolism, such as the process of DNA replication or repair.

The tertiary structure is the nucleosome model of the chromosome. It is formed by coiling a double helix in space, into a so-called superhelix. The nucleosome is formed by a core of eight histone proteins, consisting of two copies of H2A, H2B, H3 and H4, around which DNA is wrapped. The DNA is formed by the process of superhelical synthesis into chromatin.
Thanks for your attention!