

IPK research team: Protein complex SMC ensures the dynamics of holocentromeres



Gatersleben, 06.08.2021 Monocentromeres are typical for the chromosomes of most animals and plants. The centromere is necessary for the transport of the chromosomes and represents the connection point between the chromatids. This is how the classic X-shape of the chromosome is formed. However, in an estimated 350,000 species, including butterflies, nematodes and some plants, the centromeres are distributed along the entire length of the chromosome. For this reason, they are called holocentromeres.

A research team at the IPK Leibniz Institute has now used modelling to investigate how the centromere changes dynamically in the course of a cell division in these species.

The results have now been published in the journal *Nucleic Acids Research*.

Holocentric plant species such as *Cyperus papyrus* were already of great importance to the ancient Egyptians. "This fibre plant was used to make one of the first papers back then," says Prof. Dr. Andreas Houben, head of the Chromosome Structure and Function research group at the IPK Leibniz Institute. What all these species have in common is an evolutionary advantage. If a piece of the chromosome breaks off due to mutagenesis, the corresponding fragment is lost in monocentric species. "This does not happen in holocentric species, because there the centromere extends over the entire chromosome," explains the IPK scientist.

However, the research team now wanted to know how the process of cell division takes place in these species. First, the spindle fibres dock onto the centromere and then pull the two chromatids apart. "This works like a rubber band," explains Prof. Dr. Andreas Houben. In the so-called interphase, the holocentromere falls apart and innumerable centromeric units are formed, which are evenly distributed in the cell nucleus. In the subsequent mitosis, the chromosome condenses and the centromeric units form step by step a linear centromere along the chromatids.

With the help of modelling, IPK junior scientist Dr. Amanda Câmara from the Domestication Genomics research group led by Dr. Martin Mascher was able to prove that a so-called SMC protein complex plays a decisive role in this process.

"When the protein complex comes close to a centromeric unit, it becomes fixed on the chromatin thread," explains Dr. Amanda Câmara. As a result, several loops are formed, the chromosome is thus condensed and a centromeric line is formed, which ultimately gives rise to the new holocentromere. "This makes the SMC complex quite essential for the dynamics of holocentromeres. This possible function of the SMC discovered through modelling was previously unknown," says the IPK scientist.

In the next step, the researchers at IPK will try to confirm the results of the modelling experimentally.

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