

# Replicative aging

The ability of cells to divide is limited. As the passages progress, morphological, biochemical and molecular changes related to the aging process are evident *in vitro* cell cultures. After a certain number of cycles, cells such as human fibroblasts (the most commonly used cell model of "normal" cells) stop dividing, even if the culture medium provides all the necessary nutrients. The limitation of the number of cell cycles is the essence of the so-called **replicative aging** (senescence), which eventually leads to the arrest of the cell cycle in the G<sub>1</sub> phase of interphase. However, cells do not have to die after replication has stopped, they can remain in this stage for several years in cell culture with regular replacement of the culture medium.

The division frequency of human fibroblasts cultured *in vitro* and the subsequent arrest of mitotic activity were described in 1961 by L. Hayflick and P. Moorhead<sup>[1]</sup>. Later, similar results were obtained on other types of cell cultures: epidermal keratinocytes, endothelial, adrenocortical, glial cells, T-lymphocytes,  $\beta$ -buňkách pankreatu  $\beta$ -cells or smooth muscle cells. The limitation of cell proliferation *in vitro* is called the **Hayflick limit**. On average, human cells can go through about **50** cell cycles *in vitro*. Unlike cell lines derived from normal cells, tumor cells can be cultivated indefinitely. A classic example is the cervical carcinoma cell line (**HeLa**), which has been maintained for more than 50 years.

Closely related to replicative aging is the length of telomeres, the indispensable terminal parts of the nuclear chromosomes of eukaryotes.

## Links

### related articles

- Telomeres and telomerase
- Structure of the metaphase chromosome
- Characteristics of tumor-transformed cells
- Genetics causes of the aging process and death
- Autophagy, Hayflick limit, telomerase

### Reference

1. HAYFLICK, L – MOORHEAD, P S. The serial cultivation of human diploid cell strains. *Exp Cell Res.* 1961, vol. 25, no. 26, p. 585-621, ISSN 0014-4827. PMID: 13905659 (<http://www.ncbi.nlm.nih.gov/pubmed/13905659>).