Cell cultures

Content

History

French surgeon and biologist Alexis Carrel (1873-1944) At the end of the 19th century, it seemed impossible to keep plant or animal cells taken from a living organism alive. Nevertheless, the first successful attempts took place in the early 20th century. The first to prove that organs or tissues can be kept alive for a long time even after being removed from the body was the French doctor and Nobel Prize winner Alexis Carrel(1873–1944). It is necessary to ensure optimal conditions for reproduction. In 1912, he made an experiment in which he put a piece of chicken heart into the nutrient solution, the cells of which remained in the culture vessel for a full 27 years. This experiment caused a breakthrough in the early history of biology and was important for the development of genetic, microbiological and pharmaceutical methods. Carrel wrongly thought that any cells could be cultured indefinitely. In fact, the ability of cells to divide is limited by the so-called Hayflick limit .

Animal cell cultures

Animal cell cultures also include human cell cultures , which are important primarily for cell therapy. According to age, animal cell cultures can be divided into three groups:

1. primary line
2. cell lines
3. cell lines

Primary cultures

They consist of cells taken directly from the body. This type of culture has only a short lifespan , which is calculated for only a few days, after which the cells need to be transferred to a new medium (passage). In primary cultures, cells that are better adapted to the culture conditions are primarily selected.

Cell strains

Cell strains are formed on the basis of primary cultures from cells that have been passaged at least once . It is a culture of normal diploid cells (as opposed to cell lines) that withstand an average of 40-50 divisions and then die.

Cell lines

The cell line represents a culture of cells that have virtually unlimited viability and the ability to unrestricted cell division . This type of culture arises from cell lines through transformation or can be isolated directly from living tissue (e.g., tumor cells that fail by cell cycle regulatory mechanisms). An example is HeLa cells , isolated in the 1950s from cervical cancer *by Henrietta Lacks* . Cell cultures

Plant cell cultures

In medical practice, we can also encounter plant cell cultures less often. The principle of their origin is practically no different from the origin of animal cell cultures. However, because the cells do not leave the plant tissue after being transferred to the nutrient medium, we transform the original tissue into a so-called callus , an unorganized cluster of cells formed from the original tissue that can be preserved in culture for a long time. However, in contrast to animal cells, after inducing suitable conditions, by changing the composition of the nutrient medium, it is possible to induce a reverse transformation into a basic germ cell and then differentiate into another plant organ without radical cell change, as in metaplasia . Growth curve of bacterial culture

Cell culture growth curve

The growth of cells in culture is characteristic and can be described by the so-called growth curve , which consists of four parts:

1. Lag phase - the first phase, the number of cells first decreases slightly (adaptation of cells to the medium) and then begins to increase.
2. Log phase - the number of cells grows exponentially, the cells use all nutrients for their metabolism, in this phase the cells are suitable objects for cytogenetic examination .
3. Stationary phase - cell growth stops, nutrient depletion, accumulation of metabolites and toxins begin to manifest.
4. Dying phase - the final phase, maintaining the culture is no longer possible, because nutrients have been depleted, pH has decreased, metabolites (eg CO 2) and toxins have accumulated, in this phase it is necessary to transfer the cells to a new medium .

Use of cell cultures

Animal cultures are of great importance, especially in genetics for prenatal cytogenetic examination , where we cultivate cells collected, for example, by amniocentesis from amniotic fluid or postnatally to collect peripheral blood lymphocytes (most often), or fibroblasts, bone marrow cells and tumor cells. Furthermore, cell cultures are used to study the cell cycle and its regulation, in mammalian cloning experiments and in genome mapping .

In immunology , they are used to produce monoclonal antibodies , so-called hybridomas .

In microbiology , cell cultures are used to capture viral agents and bacteria that are unable to survive without the host cell (*Chlamydia , Rickettsia*).

For more information, see In vitro bacterial growth .

Plant cell cultures are used mainly in agriculture for the breeding of new varieties and in the development of genetically modified crops .

Links

related articles

- Bacterial multiplication in vitro
- In vitro cell and tissue culture, importance in medicine
- Basic techniques of working with tissue cultures
- Chromosome examination
- Replicative aging

References

- KOČÁREK, Eduard, Martin PÁNEK and Drahuše NOVOTNÁ. *Clinical cytogenetics I: introduction to clinical cytogenetics: examination methods in clinical cytogenetics.* 1st edition. Prague: Karolinum, 2006. 120 pp. Textbooks of Charles University in Prague; ISBN 80-246-1069-8 .