

# FUNGI AS A SOURCE OF PHARMACEUTICAL RAW MATERIALS AND MODEL OBJECTS IN BIOTECHNOLOGY

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**Introduction.** In ancient times, there was a tendency to perceive fungi as a panacea. Some species were used in medicine due to their external signs (magic of similarity), rather than the presence of active substances. Fungotherapy - the science of mushroom treatment - originated about 5000 years ago and is preserved in the modern world. Very often, medical and food use of fungi is combined, and the same species is cultivated both as food and as medicinal.

**Aim.** Study of scientific literature on microbiological and pharmaceutical aspects of biologically active substances from fungi.

**Materials and methods.** Various information sources of Internet system, interlibrary loan and scientific library were used. An analysis of the pharmacological substances from fungi with antimicrobial antitumor and immunomodulation activity.

**Results and conclusions.** The following types of effects and prospects for the use of fungi are shown: immunomodulatory activity; anti-inflammatory activity; antitumor activity; antiviral activity (including, against HIV); antibiotic activity against fungi and bacteria, as well as protozoa; toning action; in the treatment of Alzheimer's syndrome; as a supplements, a source of antioxidants and vitamin precursors.

In the medicinal properties of fungi contribute both any chemical compounds: polysaccharides, proteins, lipids, terpenoids, polyketides, alkaloids and intermediate compounds of protein synthesis. These substances are both primary, as well as secondary (not associated with growth, development and reproduction) metabolism. Bazidial macromycetes can have application as tonic, immunomodulating and anticancer agents, as well as antiviral and antimicrobial, but the active principle is not always known.

The active substances of macromycetes are the structural polysaccharides of fungi contained in the cell wall. These are various glycans, predominantly beta-glycans, as well as glycoproteins acting on the human immune response and suppressing (indirectly or directly) the growth and development of cancer cells, affecting apoptosis and gene expression.

In addition, terpenoid compounds (a class of hydrocarbons - biosynthetic products of the general formula  $(C_5H_8)_n$ , with a carbon skeleton formally derived from isoprene, inhibiting the growth of tumors can be used.

Anticancer activity due mainly to structural polysaccharides, it was reliably detected and studied in 28 species of fungi, mainly basidial (Zhang et al., 2007). Peptides and other compounds also have activity. Gregory, 1966: active compounds are known from fruit bodies of more than 200 species and from 7000 samples of culture fluid when immersed in culture. The main ways of action: strengthening the body's immune response (the predominant type of beta-glucans influence); direct exposure to cancer cells (De Silva et al., 2012). The most promising species of fungi are *Schizophyllum commune*, *Lentinula edodes*, *Ganoderma lucidum*, *Grifola frondosa*, *Trametes versicolor*.

Demonstration of the effect: prevention of carcinogenesis (in Japanese villagers, constantly consuming winter fungus, *Flammulina velutipes*, as well as the Brazilians who fed *Agaricus blazei*, the cancer mortality was 40% lower than. On average in the region's population, was subsequently confirmed by experiments with the induction of cancer in mice. Increased immune response (inhibition of tumor growth); direct activity that causes apoptosis of cancer cells (in general, the effect on cell culture in vitro has unclear mechanisms, but in some cases the effect of stopping the cell cycle and stimulating apoptosis, including at the level of gene expression) is shown. Lentinan is a glucan used since 1985 in Japan for the treatment of stomach cancer. Lentinex is a food supplement.

Micromycetes from Ascomycetes are recognized producers of antibiotics that suppress the development of Gram-negative and Gram-positive bacteria, Fungal antibiotics were in their heyday in the so-called "fungi". "The era of antibiotics", the second surge of interest in them began in the last years of the XX century. And is observed now.

The first survey of fungal antibiotics was made by G. Flory (Florey, 1949) and included more than 2000 species of fungi. The chemical groups of beta-lactam, terpenoid, furan, and other fungal antibiotics. Cephalosporins are the most commonly used antibiotics, to the present moment 5 generations have been known. Discovered in 1948 by Giuseppe Brotz, who showed the activity of cultures against the causative agent of typhus. More than 10,000  $\beta$ -lactam antibiotics are now known, but semisynthetic ones predominate. In medicine, about 70 preparations are used.

Fuzidine is similar in structure with steroid hormones and cholesterol. Effects on Gram-positive bacteria, including those resistant to penicillins. Relatively non-toxic, although allergic reactions are known. It is used mainly for the treatment of bronchitis and skin diseases.

Griseofulvin is result of action on mycelial fungi. Dermatophytes (disturbance of mitosis, protein synthesis and formation of the cell wall due to influence on the cytoskeleton). It has no acute toxicity, a selective effect on the division of tumor cells is shown.