effects, but the minimum size and higher concentration of CuNPs demonstrate a wider zone of inhibition (Crisan, 2021).

Consequently, nanoparticles are increasingly being used as an alternative to antibiotics. Nanotechnology can be effective in the treatment and prevention of bacterial and fungal infections, which makes it possible to use them in antibacterial coatings for implanted devices, medical materials to prevent infection and promote wound healing, and antibacterial vaccines (Longano, 2012).

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THE VALUE OF TRICHODERMA IN BIOTECHNOLOGY

Trichoderma are soil green-spored ascomycetes, distributed worldwide and numbering about 370 species, 20 of which are actively used in agronomic biotechnology as bio-fertilizers and bio-fungicides. This is possible due to the physiological properties of *Trichoderma* spp. - the fungus has high adaptability, rapid growth of mycelium, symbiotic interactions with plants and several antagonistic mechanisms against pathogenic fungi and bacteria (Tyśkiewicz, 2022).

Trichoderma exhibits antagonistic activity against more than 18 species of pathogenic fungi, including *Pythium*, *Phytophthora*, *Rhizoctonia* and *Peronospora*, which are causative agents of root rot, late blight, potato scab and downy mildew. The main mechanism of suppression of pathogenic micromycetes is hyperparasitism (Korkom, 2023). *Trichoderma* is able to grow around the hyphae of the host, attach to

it and penetrate inside, inhibiting the development and deforming the cells, stretching, squeezing them or even destroying the cell walls with the help of enzymes (Yao, 2023).

Trichoderma also produces a wide range of secondary metabolites. In addition to the above-mentioned enzymes, *Trichoderma* is capable of synthesizing peptaibols, polyketides, pyrones, terpenoids, steroids, polythecids, etc. (Yao, 2023). A significant number of them, in addition to fungicidal properties, also demonstrate antimicrobial properties, considerable nutritional value and the ability to improve plant growth. *Trichoderma* secondary metabolites are able to suppress the growth of colonies of pathogenic fungi at different levels, some can inhibit the growth of colonies by more than 80% (Tyśkiewicz, 2022).

Trichoderma also breaks down some toxic pollutants - for example, *T.viride* is able to decompose trinitrotoluene (TNT). In addition, *Trichoderma* has an effect even on some diseases caused by nematodes. For example, in a study conducted on tomato seeds, *T.harzianum* was found to effectively penetrate the mass matrix of nematodes and to have an effect on eggs. In another study conducted on soybeans, *T.asperellum* and *T.harzianum* prevented the penetration of *Pratylenchus brachyurus* by secreting compounds with nemacidical properties. The data demonstrate the potential of *Trichoderma* in protecting plants from insect pests - such as aphids, mealybugs, caterpillars - through several mechanisms, the most important of which are parasitism, production of insecticidal secondary metabolites and reduction of damage from them by directly activating the plant's defense mechanisms (Tyśkiewicz, 2022).

Trichoderma is able to activate the defense mechanisms of host plants. In addition to inhibiting the growth and reproduction of pathogenic fungi, it stimulates crops to form self-defense systems, providing both local and systemic resistance to diseases. This effect is achieved in two ways. The first is by regulating plant resistance responses through the influence on elicitors and effectors. The second is due to *Trichoderma* enzymes that destroy the cell walls of pathogens and release oligosaccharides that induce protective reactions in plants (Tyśkiewicz, 2022).

This is ensured by the symbiosis of *Trichoderma* and the host plant. *Trichoderma* colonizes root systems, after which, through the production of secondary metabolites, it stimulates growth and strengthens the plant's protective system. The fungi colonize edge cells of the roots to obtain plant sucrose, after which *Trichoderma* in turn begins to

produce phytohormones, in particular gibberellins. In addition, they increase the solubility of rhizosphere nutrients, for example phosphates, iron, magnesium (Tyśkiewicz, 2022).

Trichoderma is a highly effective biological agent that combines the ability to antagonistic action against pathogenic microorganisms with a beneficial effect on plant growth and resistance. Its wide range of mechanisms - from hyperparasitism and synthesis of secondary metabolites to activation of plant immune responses - makes it promising for use in agronomic biotechnology. In addition to protection against pathogenic fungi, *Trichoderma* has demonstrated the ability to degrade toxic substances, as well as to suppress nematodes and insect pests. Its symbiotic interaction with plants not only contributes to increased disease resistance, but also stimulates crop growth by producing phytohormones and improving nutrient availability. Due to these properties, *Trichoderma* is becoming an important component of sustainable agriculture, ensuring increased yields and reduced use of chemical fungicides.

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APPLICATION OF BACTERIAL CELLULOSE IN THE MEDICAL FIELD

Introduction. Bacterial cellulose (BC) is an innovative material that attracts considerable attention from researchers due to its unique properties. It finds application in various fields, including biomedicine, food industry, pharmaceuticals, cosmetology and bioengineering. The use of BC in medicine is particularly promising, where it is used for wound dressing, creation of bio-implants and tissue regeneration. Due to its