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# PIGMENT-PRODUCING MICROORGANISMS: A SOURCE OF NATURAL DYES

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**Abstract:**The state discusses the fact that microorganisms are one of the most important and widespread representatives of their nature and that they are of great importance not only in the processes of decomposition, but also in the muscular, medical, ecological and food spheres. In recent years, special attention in science and practice has been attracted by pigment-producing microorganisms, antioxidant and antibacterial pigments have the potential for wide application in pharmaceuticals.

**Keywords:**Pigment, industry, medicine, ecology, food industry, antioxidant and antibacterial drug, Rifampicin, Prodigiosin.

**ABSTRACT**

The article discusses the fact that microorganisms are one of the most important and widespread representatives of living nature and that they are of great importance not only in the processes of decomposition, but also in the industrial, medical, ecological and food spheres. In recent years, pigment-producing microorganisms have attracted special attention in science and practice, and antioxidant and antibacterial pigments have the potential for widespread use in pharmaceuticals.

**Keywords:** Pigment, industry, medicine, ecology, food industry, antioxidant and antibacterial, Rifampicin, Prodigiosin.

As you know, the decrees No. PF-20 of 01/23/2024 and No. PF-13 of 01/28/2025 "On additional measures for the accelerated development of the pharmaceutical industry in 2022-2026" are currently in force.

If we talk about pigments and their biological role, then in recent years, pigment-producing microorganisms have attracted special attention in science and practice. The natural pigments they synthesize are used in various industries as an alternative to synthetic dyes. Pigments are colored organic compounds that have the property of absorbing light. Pigments synthesized by microorganisms often perform protective or signaling functions in their environment. For example, it can protect against ultraviolet radiation, compete with other microorganisms, or perform warning (toxic) functions.
We know that there are many different types of microorganisms that produce pigments.
Many microorganisms have the ability to produce pigments. The most important of them are:
1. Bacteria: Serratia marcescens (pigment prodigiosin), Pseudomonas aeruginosa (pyocyanin, pyoverdin), Chromobacterium violaceum (violacein).

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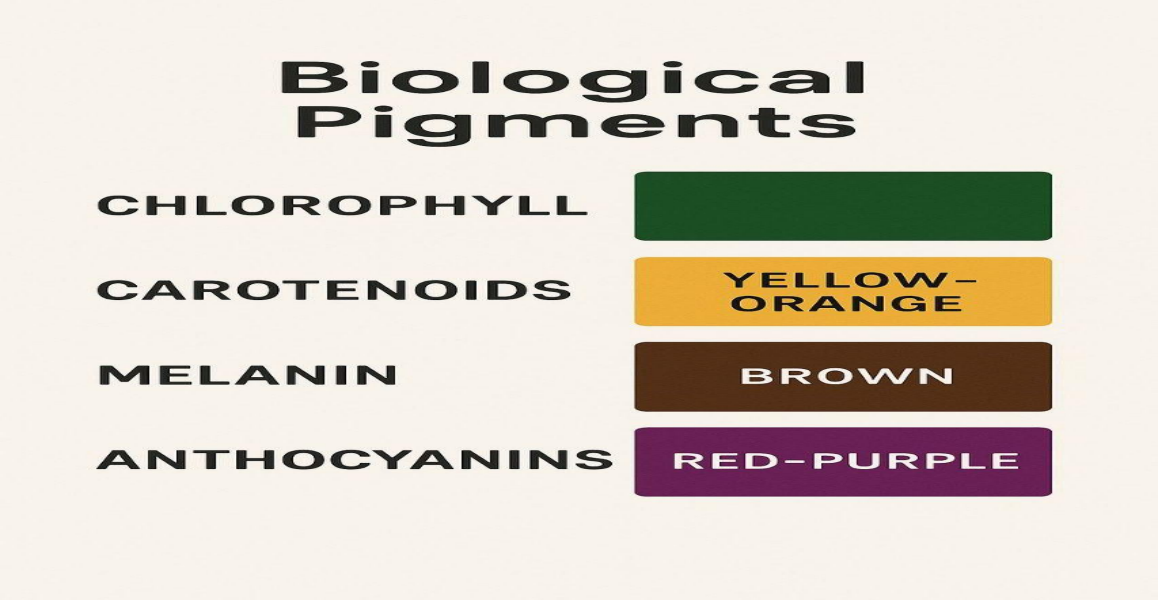
2. Fungi (mycetes): Monascus purpureus produces red, yellow and orange pigments. These pigments are used in the food industry.
3. Actinomycetes: Bacteria belonging to the genus Streptomyces produce a variety of color pigments, including those with antibiotic properties.
4. Algae and microalgae: for example, Spirulina platensis (phycocyanin pigment) has natural antioxidant properties.




Pigments are of particular importance in industry.Pigments produced by microorganisms are natural, biodegradable and non-toxic. Therefore, they are widely used in the following areas:
Food industry: as a natural dye (Monascus, Spirulina pigments).
Pharmaceutics: pigments with antioxidant, antibacterial and antitumor properties. The use of natural and synthetic pigments in modern pharmaceuticals is becoming increasingly important not only from an aesthetic but also from a therapeutic point of view. In particular, pigments with antioxidant and antibacterial properties play an important role in increasing the effectiveness of drugs, reducing side effects and protecting the body.
Cosmetics: used in skin protection products and dyes.Environmental monitoring: some pigments are produced in response to toxic substances, which allows them to be used as biosensors.A general description of pigments is as follows.Pigments are biologically active substances that have their own coloring and bioactive properties. They are obtained from natural sources (plants, animals, or microorganisms) or by artificial synthesis.

**1. Antioxidant pigments**

Antioxidant pigments protect cells from oxidative stress. They neutralize free radicals, slow down the aging process, and are useful for the prevention of cancer, cardiovascular disease, and other chronic diseases.
Major antioxidant pigments:
Carotenoids (beta-carotene, lycopene)
Flavonoids (anthocyanin, quercetin)
Chlorophyll is the main green pigment of plants.

**2. Antibacterial pigments**

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Antibacterial pigments act as natural antibiotics to fight bacteria. They help fight infections by killing germs or stopping their growth.
Popular pigments:
Rifampicin – obtained from the bacterium Streptomyces rifamycinica
Prodigiosin – isolated from the bacterium Serratia marcescens
In pharmaceuticals, these pigments are used in the following areas:
Creams, ointments and lotions – accelerate skin regeneration, relieve inflammation
Tablets and capsules – have an internal effect on the body
Antiseptics – effective against microbes
Cosmetics – to maintain youthful skin and fight inflammation
For example, lycopene prevents skin aging due to its powerful antioxidant properties, and rifampicin is used as the main drug against tuberculosis.

**Conclusion**

Pigment-forming microorganisms are natural, environmentally friendly and multifunctional biological resources. They can be used to produce environmentally friendly paints, medicines, food additives and many other products. In the future, microbial pigments will become a sustainable and healthy alternative to synthetic dyes.

Antioxidant and antibacterial pigments have a wide range of applications in pharmaceuticals, playing an important role not only in appearance but also in restoring and maintaining health. In-depth study of the therapeutic value of these pigments and their inclusion in pharmaceutical formulations is one of the current areas of modern medicine.Optimization of the production of microbiological pigments.The synthesis of pigments depends on the growth conditions of microorganisms: the type of nutrient medium, pH, temperature, light intensity and aeration conditions affect the intensity of pigment formation. Thanks to modern biotechnological methods, these conditions are optimized, and high-quality pigments are obtained on a large scale.

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