PROSPECTIVITY OF DEVELOPMENT OF TECHNOLOGIES OF OBTAINING MICROBIAL PIGMENTS

Kaliuzhnaia O.S. [1], Khokhlenkova N.V. [1], Loseva M.V. [2]
[1]National University of Pharmacy, Kharkiv, Ukraine
[2]Ukrainian Fashion Education Group, Kharkiv, Ukraine
kalyuzhnayao.s@gmail.com

Introduction. Today, the fashion industry is one of the most polluting industries in the world. One in two liters of waste water, every third factory pipe and every fifth exhaust "on the conscience" of the fashion industry. Today, the degree of environmental anxiety in society is rising, and the idea of reducing the number of "unnecessary rags" in the wardrobe, the rejection of "decorative" in favor of "functionality", the concept of consumer minimalism is becoming more popular. That is why the term "Sustainability" is becoming widely used. Sustainable development is a set of measures that need to be taken by industry, in particular the fashion industry, in order to reduce damage to the environment, while improving the economic and social situation. First of all, sustainable development is the interaction of industry and ecology.

One of the "most polluting" stages of clothing production is the dyeing of fabrics. It is because of the understanding of the harmful effects of synthetic pigments and their industrial by-products on humans and the environment that the use of natural pigments as dyes has been growing in recent years.

Purpose of the research. Therefore, the aim of the work was to analyze the existing scientific developments on alternative ways to obtain pigments for dyeing fabrics and to identify the stages of our own further work on the development of ecofriendly and sustainability textile dyes.

Materials and methods. The method of descriptive research was used.

Obtained results. Natural pigments can be obtained from two main sources - plants and microorganisms. The available natural pigments from plants currently in use have numerous disadvantages, such as instability under the action of light, heat or adverse pH, often low solubility in water and inaccessibility of production during the year due to the seasonality of growth of specific plants.

The advantages of pigment production from microorganisms include easy and rapid growth on cheap nutrient media (often the media needed to feed microorganisms are waste from various industries), the absence of toxic stages and production waste, independence from weather conditions and the ability to obtain colors of different shades. Thus, the production of microbial pigments is one of the new areas of research potential for use in various industries.

Many microorganisms in the process of life emit pigments, that give them a variety of colors and shades. The formation of pigment for a number of microorganisms is a stable feature of the species used in their identification. But not all microorganisms are able to form pigments. Pigments for microorganisms are secondary metabolites that do not play a key role in metabolism, are used by the microorganism as a protective factor and a way to increase their viability. Today, the "biological" significance of specific pigments is still being studied; it is known that some pigments perform the function of protection against sunlight, some pigments are involved in the process of respiration, and some - have antibacterial action.

Today, at various stages - from research projects to industrial production - are technologies for the following groups of microbial pigments: Monascins, Carotenoids, Quinones, Riboflavin, Flavins, Prodigiosin, Melanins, Violacein, Indigo, etc. To obtain them use producers of the following genera: *Monascus, Mucor, Phycomyces, Blakeslea, Flavobacterium, Xanthomonas, Aspergillus, Penicillium* and many others.

When developing technologies for obtaining pigments with the help of microorganisms, some features of their pigment formation should be taken into account. Thus, the formation of pigments by certain microorganisms in natural conditions does not always occur, but under the influence of certain factors. For example, the formation of carotenoids by *Mycobacterium tuberculosis* (or *Mycobacterium lacticola* - producer of keto derivative beta carotene astaxanthin, Astaxanthin) occurs only when exposed to light. That is why for the use of a particular microorganism in laboratory and industrial conditions as a producer of pigment, you need to select specific conditions and grow this producer under selected conditions.

Also, many microorganisms naturally emit a small amount of pigment, and the color obtained by the formation of pigment by the microorganism depends on the concentration of the pigment (for example, the formation by one producer of color of different shades from light yellow to red-orange), so for use in on an industrial scale, the natural producer is selected and modified, in particular to obtain superproducers. Thus, during the screening of pigmented microorganisms, a strain of *Gordonia jacobaea* MV-1 was isolated, capable of accumulating several carotenoids, including keto-carotenoid trans-canthaxanthin. However, the low content of carotenoids (200 μg/g dry weight) makes it unsuitable for industrial production. But after several rounds of mutations, a hyperpigmented mutant (*Gordonia jacobaea* MV-26) was obtained with enhanced accumulation of Canthaxanthin and β – Carotene, which accumulates six times more Canthaxanthin than the wild-type strain, staining the environment in deep red and orange.

In addition, the microorganism can secrete a mixture of pigments, and the formation of a particular pigment from this mixture depends on the growing conditions, exposure at the strain and methods of isolation and purification. For example, Monascins are produced by 9 species of *Monascus: M. purpureus, M. pilosus, M. ruber, M. floridanus, M. argentinensis, M. eremophilus, M. lunisporas, M. pallens M. sanguineu. Monascus spp.* form a mixture of pigments of polyketide nature of different colors: yellow - Ankaflavin, I and Monascin, II, orange - Monascorubrin, III and Rubropunctatin, IV, red - Monascorubramine, V and Rubropunctamine, VI. *M. purpureus* is more often used as an industrial producer, in the application of which the structure of the pigment forming the producer depends on the type of substrate and other specific factors during cultivation, such as pH, temperature and moisture content.

It should also be borne in mind that a certain pigment can be formed by different types of microorganisms, and as an industrial producer is chosen the most "convenient" from a technological point of view. Thus, the largest amount of carotene is produced by producers from the class of fungi *Zygomycetes* of the order *Mucorales: Mucor, Phycomyces* and *Blakeslea*. Also, *Basidiomycetes* produce carotene*: Ustilago, Sclerotinia, Sporidiobolus* and *Rhodosporidium* and members of the genus *Ascomycetes: Aspergillus, Penicillium, Aschersonia and Cercospora*. But as an industrial producer often use a well-studied soil fungus *Blakeslea trispora*.

Conclusions. Given the needs of society in safe for humans and the environment products and the lack of domestic developments in textile microbial pigments, research on the development of technologies for the production of pigments by microbial synthesis is promising, so the Department of Biotechnology NUPh in cooperation with Ukrainian Fashion Education Group started work in this direction. Today, the search for producers among actinomycetes *Streptomyces spp*., among the pigments of which the most studied are melanin. These same pigments form mycelial fungi, such as the genus *Aspergillus*, which, like actinomycetes, are widespread in the environment, making them readily available for further study. For the same reasons, it is planned to work with the fungus *Blakeslea trispora*, which is widely used, including in Ukraine, to obtain oil extracts of vitamins beta-carotene, food dyes.