Journal of Young Scientist, Volume X, 2023
ISSN 2344 - 1283; ISSN CD-ROM 2344 - 1291; ISSN Online 2344 - 1305; ISSN-L 2344 – 1283

THE WONDERS OF THE MICROBIAL WORLD – STATE OF THE ART

Vlad EFTIMIE, Mirela COTUNĂ, Gina BUJOR

Scientific Coordinator: Assoc. Prof. Biotech. PhD Irina GREBENIȘAN

University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Mărăşti Blvd, District 1, 011464, Bucharest, Romania, Phone: +4021.318.25.64, Fax: + 4021.318.25.67, Email: vladeftimie145@gmail.com

Corresponding author email: vladeftimie145@gmail.com

Abstract

In this paper we want to present a short review about the amazing activity of microorganisms, which does not cease to surprise us and the various fields of activity where they can be used. Due to the fact that microorganisms have existed on earth for almost 4 billion years, they have been able to develop very complex metabolic pathways that have allowed them to occupy various ecological niches and survive. Also, the complex relationships that have been established over time between different types of microorganisms, and that have begun to be discovered and understood by researchers, open new perspectives for the development of new technologies and environmentally friendly products.
Microorganisms continue to amaze us with their incredible properties: they can be excellent builders, producers of natural pigments for nontoxic dyes, producers of nanoparticles and nanomaterials, purifiers of contaminated air, water and soil, skilled decomposers of countless chemicals (even xenobiotic), recyclers of matter in biogeochemical cycles, etc.
In this paper we will draw attention to how microorganisms can be included in state of the art technologies and products that help the sustainable development of human society in the near future. Thus, we will talk about: eco-friendly biological bricks, building materials from mycelium, biocomposite, the healer fungus, algae-grown limestone concrete, electricity-generating bio-panels, fungi for everyday products, natural microbial dye, bacteria and amazing spider silk.

Key words*: algae-grown limestone concrete, bacteria and amazing spider silk, building materials from mycelium, biocomposite, the healer fungus, eco-friendly biological bricks, electricity-generating bio-panels, fungi for everyday products, natural microbial dye.*

INTRODUCTION

Microorganisms continue to amaze us with their incredible properties:

- ✓ they can be excellent builders,
- ✓ producers of natural pigments for nontoxic dyes,
- ✓ producers of nanoparticles and nanomaterials,
- ✓ purifiers of contaminated air, water and soil,
- ✓ skilled decomposers of countless chemicals (even xenobiotic),
- ✓ recyclers of matter in biogeochemical cycles, etc.

Moreover, microorganisms can be used in HCI applications – Human Computer Interaction.

Human Computer Interaction

The integration of living organisms into interactive systems is a growing area of interest for HCI and design researchers.
Organisms have been embedded in interactive installations, hybrid computer games, wearables and interface designs, in which novel functionalities and interaction possibilities are achieved through substitution of computer input and output with living media.
The ability of living organisms to dynamically change the color of an artefact has been harnessed in diverse ways in HCI and design, for example, through pigment producing bacteria, fluorescent bacteria or bioluminescent algae.
Flavobacteria can add to this repertoire by changing the color of an artifact through their structural color. These bacteria, which can be found in marine environments, are able to grow as part of a densely organized colony. Through this multicellular organization, they form photonic crystals which reflect light in specific

ways, creating striking visual effects.
Microbiologists have researched *Flavobacteria's* ability to self-organize in relation to various abiotic factors, the presence of other microbes, etc. However, despite their vivid colorations and highly responsive behavior, *Flavobacteria* are yet to be explored as a living medium for human-computer interaction design.

Eco-friendly biological bricks

Start-up company BioMason is currently working towards a debut of a new kind of eco-friendly brick 'grown' with sand and bacteria.
The construction industry currently accounts for around 40% of work emissions. Used in over 80% of building construction projects, bricks are a large contributor to this, generating approximately 800 million tonnes of carbon emissions per year, which more than the amount produced by all the planes in the world each year. That is a lot of pollution from one relatively simple material.
BioMason's eco-friendly bricks also use the natural process of calcification to gain their structure and strength. To create the bricks, sand is put into a mold and then inoculated with bacteria (*Sporosarcina pasteurii*). These bacteria are fed with calcium ions suspended in the water. The ions are attracted to the cell walls of the bacteria, creating in a calcium carbonate shell and the basis for a strong brick.
Unlike traditional bricks that requiring days of firing and produce large amounts of emissions as a result, BioMason's biological bricks are grown in only two to three days – and they are emission free. As an added bonus the bricks can actually even absorb pollution and include other characteristics such as glow in the dark and colour change properties.

Natural microbial dye

Fashion colours change each year, yet one thing doesn't seem to change: the polluting nature of dye, leaving whole rivers dirty with chemicals and pigments.
Fabulous bacteria & fungi are the solution to one of the major problems in the fashion industry; the use of synthetic textile dyes. Enormous amounts of harmful chemicals are involved with this conventional dyeing method, which causes water pollution, health problems and a significant demand of water and energy. Fabulous bacteria & fungi employ microorganisms in order to create sustainable and safe textile dye, without the use of harmful chemicals.
One solution to these harmful dyes may be found in bacteria & fungi. Pigment-producing bacteria & fungi do not require harmful chemicals for the dyeing process.
The biochemical processes of these bacteria and fungi produce pigments. These pigments, which form the basis of the textile dye, are biodegradable. This means it won't cause any water pollution. In addition, bacterial and fungal dyes require less water and energy. All in all, bacterial and fungal dye will have many benefits over synthetic textile dye and other alternatives.

Building materials from mycelium

Durability

Biohm believes that materials should be made to last as long as their intended use and that sustainable and circular end-of-life considerations should be embedded into the product itself. Independent insitu testing of mycelium has demonstrated that they are at least as durable as conventional materials and retain their performance over their life. The material can then be fed back into the manufacturing process or otherwise cold composted.

Biocomposite

One of the interesting biocomposites, the object of research at the CoEBBE, is called Nabasco. This is a composite that consists of a resin, a fibre and a filler. The ingredients can vary depending on the desired properties and esthetics.

The healer fungus

Researchers at Binghamtom University & Rutgers University are working on a solution for broken concrete. They discovered that adding fungus to the mix could cause the

concrete to heal itself.
Concrete expands and shrinks during everyday use, because of heat and moisture, which causes the concrete to crack. Microcracks can allow water and oxygen to infiltrate, which, in case of reinforced concrete, can cause the steel to corrode.
The researchers started looking for a way to create a concrete that can heal itself, like a living organism. They found an unusual candidate for the job: a fungus called *Trichoderma reesei*.
As the calcium hydroxide from concrete dissolves in water, the pH of the fungal growth increases from a close-to-neutral value to one that is very alkaline. Of all the fungi tested only T. *reesei* survived that environment. Despite the pH increase, the spores keeping germinating to mycelium. T. *reesei* is eco-friendly and nonpathogenic, posing no known risk to human health.

Electricity-generating bio-panels

Mexican start-up Greenfluidics developed a solar bio-panel that integrates CO2 capturing, the production of oxygen, and the production of energy through the use of micro-algae.
Photosynthesis is a natural process by which plants and algae produce energy, organic matter and oxygen using sunlight and carbon dioxide from the atmosphere. This process is what powers the bio-panels. Greenfluidics says that the algae mitigate from 200 kg CO2 per year.
The algae in the semi-transparent green panel are combined with nanofluids, which take solar radiation and absorb high temperatures, creating energy. The triangular design can be installed on any type of structure.
Each bio-panel is said to be able to generate up to 328 KWh/m2 per year. In addition, due to the thermal comfort that it can provide to buildings, up to 90 KWh/m2 per year can be saved.

REFERENCES

https://materialdistrict.com/article/growing-eco-friendly-bricks-with-sand-and-bacteria/
https://materialdistrict.com/article/amazing-spider-silk/
https://materialdistrict.com/material/fabulous-fungi-dye/
https://materialdistrict.com/material/mycelium-root-structure-of-fungi/
https://materialdistrict.com/material/biocomposites/
https://materialdistrict.com/article/fungus-infused-concrete-heal/
https://materialdistrict.com/article/building-with-algae-grown-limestone/
https://materialdistrict.com/article/electricity-generating-and-co2-absorbing-bio-panels/
https://materialdistrict.com/article/building-with-algae-grown-limestone/