

## **Development of *Vishniacozyma victoriae* as a Biotechnological Platform for the Enhanced Production of Specific Carotenoids from lignocellulosic biomass**

In recent years, the search for environmentally friendly technologies has become a major priority in science and industry. One area of interest is the use of microorganisms — such as bacteria and yeasts — to produce natural compounds and help process industrial waste in sustainable ways. This project focuses on an unusual but promising yeast species called *Vishniacozyma victoriae*, which has the ability to produce both natural pigments (called carotenoids) and enzymes that break down plant-based materials.

Carotenoids are colorful compounds found in carrots, tomatoes, and other plants. They are used as natural food colorants, antioxidants, and health-promoting ingredients. At the same time, enzymes like cellulases and xylanases can help decompose agricultural waste — such as oilcakes, which are residues left after pressing oil from seeds like rapeseed or sunflower. These oilcakes are rich in lignocellulose (complex plant fibers) and are usually discarded or underused. Finding ways to turn this waste into useful products is a major challenge in circular economy and green biotechnology.

What makes *V. victoriae* particularly interesting is its origin: it comes from extreme environments (e.g., cold or nutrient-poor habitats), and it can naturally produce both pigments and enzymes under such conditions. However, this species has never been studied in depth, and there are currently no tools available to modify or improve its genetic traits. The main goal of this project is to explore and unlock the potential of *V. victoriae* as a natural factory for eco-friendly compound production.

The project will start by analyzing which genes are active when the yeast grows on waste materials and produces carotenoids or enzymes. The research team will use advanced techniques like RNA sequencing (transcriptomics) to identify key genes. Then, using DNA-editing methods — including CRISPR-Cas9 — they will develop new tools to modify the yeast's genome. These tools will allow researchers to create new yeast strains that are better at producing pigments and enzymes, especially when grown on oilcakes.

In addition to developing these genetic tools, the project also involves isolating and studying the carotenoids and enzymes produced by the yeast. The pigments will be extracted from the yeast cells and analyzed using laboratory techniques to determine their structure, color properties, and potential health benefits. Similarly, the enzymes will be purified and tested to see how well they work under different conditions (such as temperature, pH, and presence of inhibitors). This will help evaluate their usefulness for industrial applications, such as processing agricultural waste or producing food additives.

Importantly, this project will also create the first-ever protocol for genetically modifying *V. victoriae*, making it easier for other researchers to work with this species in the future. All results, including genomic data and molecular tools, will be made available through open-access databases.

The project is carried out in collaboration with a research team from INRAE Montpellier in France, which has extensive experience in yeast biology and biotechnology. In the long term, the knowledge and tools developed through this work may support the development of new sustainable technologies for waste valorization, natural pigment production, and biobased industries.