ABSTRACT FOR THE GENERAL PUBLIC

In our rapidly evolving modern world, characterized by exponential advancements in technology, industry, and lifestyle, we have witnessed a profound transformation in the socio-economic landscape. While these changes have undoubtedly contributed to improved living standards and remarkable levels of convenience, they are accompanied by a range of health challenges, particularly lifestyle-related diseases. The prevalence of conditions such as obesity, diabetes, cardiovascular diseases, and certain types of cancer is becoming increasingly alarming, casting a shadow over the narrative of progress. In response, there is a growing awareness of the necessity for innovative approaches to prevent, manage, and treat diseases.

One of the cornerstones of modern medicine is the field of pharmacy, where the search for therapeutic solutions often leads researchers to the vast reservoir of natural compounds found in plants. These bioactive molecules, with their diverse pharmacological properties, have long been the foundation for drug development, potentially being used to treat a wide spectrum of ailments. However, the journey from plant to pill is not without challenges. The process of extracting and purifying these compounds from botanical sources can be resource-intensive and environmentally consequential. The demand for large quantities of plant material, coupled with the use of chemical solvents and energy-intensive extraction methods, poses significant sustainability issues.

In light of these challenges, there is increasing interest in finding alternative pathways for the production of bioactive compounds. This is where biotechnology comes into play, with its promising utilization of the power of living organisms to produce valuable molecules in a sustainable and efficient manner. At the forefront of this biotechnological revolution are the humble yeasts *Yarrowia lipolytica*, known for their versatility and unconventional metabolism. By using genetic tools to modify these microorganisms, researchers focus on engineering new biosynthetic pathways for the efficient production of valuable metabolites, including retinoids and phospholipids.

Retinoids, derivatives of vitamin A, have gained attention for their diverse therapeutic applications, ranging from treating dermatological conditions to combating certain types of cancer. Phospholipids, on the other hand, are essential components of cell membranes, playing a crucial role in maintaining cell structure and function.

What makes this project truly groundbreaking is its holistic approach to sustainability. By rethinking the production process from the perspective of green chemistry, researchers aim to bypass the need for traditional substrates, utilizing waste materials as a growth medium for yeast. Residues from oil production (known as press cakes), fatty acids, and other organic compounds, once considered mere by-products of industrial processes, can now be transformed into valuable precursors for the synthesis of important compounds. This closed-loop system not only reduces the ecological footprint of the production process but also has the potential to lower costs and increase the availability of life-saving medications.

The path from concept to realization is multifaceted, encompassing a series of iterative steps guided by principles of metabolic engineering, process optimization, and purification processes. Through meticulous experimentation and continuous improvement, researchers strive to unlock the full potential of *Y. lipolytica* yeast as a biocatalyst for the sustainable production of bioactive compounds.

Beyond the realm of pharmacy, the implications of this research extend far beyond pioneering solutions to pressing global issues. This project stands as a testament to the remarkable power of biotechnology in shaping the future of healthcare, industry, and environmental stewardship. As we navigate the complexities of the 21st century, with its myriad challenges and opportunities, the pursuit of sustainable solutions becomes increasingly urgent. By harnessing the innate capabilities of living organisms and embracing principles of circularity and resource efficiency, we can pave the way for a brighter, healthier, and safer future for generations to come.