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7 - Waste valorization for biofuel production by oleaginous yeast

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Abstract

Due to the depletion of fossil fuels, waste accumulation, and increase in populations, human beings will face the problems of global energy supply and environmental safety, which have resulted in a rapid rise in the cost of raw materials for the production of global energy. To tackle this issue, importance has been given to utilize the wastes produced in many ways to produce value-added products such as biofuel. The wastes nowadays used for biofuel productions are agro-industrial waste, municipal waste, industrial waste, etc., but all these wastes require pretreatment to produce renewable products. The methods used for the pretreatments are physical, chemical, and/or biological methods. Among all these methods, the biological methods are more acceptable because they are cost-effective and eco-friendly. Oleaginous microorganisms (algae, bacteria, yeast, and fungi) play an essential role in valorizing waste for biofuel production. Oleaginous yeasts require less space for cultivation; they can grow on different carbon sources like agro-food waste, and the lipid produced is unaffected by season. This property makes them ideal candidates for biofuel production by producing microbial lipids, that is, single-cell oils or SCOs, and oil produced by these oleaginous microorganisms is similar to vegetable oil. This chapter discusses oleaginous yeast's capacity to transform various waste materials into value-added oils using various strategies to reduce biofuel production costs.

Previous Next

Keywords

Biodiesel; Oleaginous yeast; Solid waste; Waste-to-Energy; Wastewater

1. Introduction

Wastes are materials with the least usage or purpose that ends up accumulated all around us. The major types of waste generated globally are electronics, food, agriculture, industrial, textile, plastic, and many others. The final destination of most of the waste generated is a sanitary landfill or huge open waste dump yards, though it is one of the most hazardous forms of disposal (Di Fidio et al., 2020; Siddiqua et al., 2022). Such improper disposal can result in environmental instability such as pollution to the surface water, toxicity to groundwater, bioaccumulation in aquatic fauna and flora, and affecting soil fertility, odor, and colored water. The introduction of a sustainable form to dispose of waste will preserve the environment (Dias et al., 2020). Many methods could attain sustainable development, not just disposing of waste in an eco-friendly manner but could also produce products of industrial importance.

Waste valorization is the transformation of waste into a more valuable product. Waste valorization is the concept that stands side by side with reusing and recycling. The valorized product has a greater value. Such conversion results in high-quality chemicals, fuel, materials, energy, and products that benefit the local economy more. Incorporating microorganism in conversion is one of the most economical approaches. Among all microorganisms, oleaginous yeasts have shown promising effects in degrading waste and producing products such as biofuel (Chaturvedi et al., 2019). They also produce a variety of lipids such as glycolipids, lipoproteins, sterols, phospholipids, acyl glycerides, free fatty acids (FFA), and hydrocarbons. Thus, oleaginous yeast has added advantages over other microorganisms used for biofuel production. Growing up on a wide range of wastes, oleaginous yeast produces a good quantity of biofuel. Currently, biofuel is a need. Biofuel is above petroleum, which provides energy security, and environmental safety induces a circular economy, and provides employment to locals. Some of the major applications of biofuel are mentioned in Fig. 7.1, while the benefits of biofuels over conventional fuels are shown in Fig. 7.2**.** In this chapter, a comprehensive description of the waste and its valorization for biofuel production from oleaginous yeast is provided.

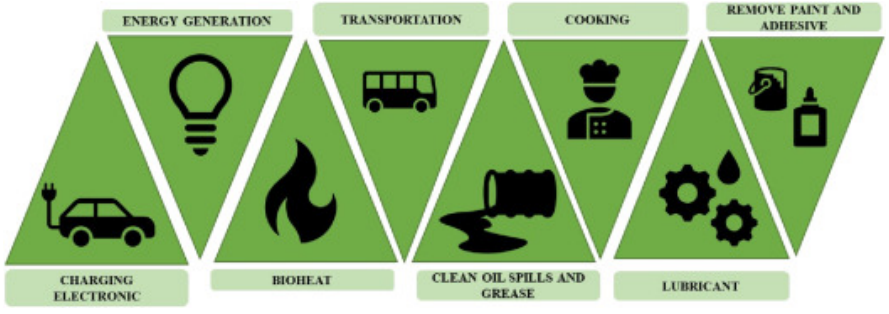

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Figure 7.1. Applications of biofuel production.