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The Importance of Polyhydroxybutyrate (PHB) to Eukaryote from Prokaryote

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Introduction

The increase of human population has caused to accumulation of enormous amounts of non-degradable waste substance in our world [1]. Increased utilize of plastic substance in the domestic and industrial section exceeds which poses critical worry as they are no biodegradable, as a result important problems such as environmental pollution, toxicity to human health. At last years, plenty of emphasis has been given in the way of the improvement of microbial-derived biodegradable polymers manufacture [2]. Many investigators prefer to utilize and manufacture biodegradable polymers from microorganism, because of controlled fabrication, simple purification, more prospects of genetic modifications with rapid biodegradability without collapsing the environment [3]. Bio-polymers are manufactured from natural renewable materials as a result of microorganisms such as, algae, yeast, and bacteria. Those microorganisms are capable of producing many biodegradable polymers in nature such as, polyhydroxyalkanoate (PHA), polyhydroxybutyrate (PHB) accumulate in cells as source of energy and carbon [4]. The synthesis of PHA polymers rises when deficiency in nutrients, carbon and lack of Mg, N, S, P etc. occurs during growth. Polyhydroxybutyrate (PHB) is classified as one of the most fundamental polymers of PHA, as it has mechanical characteristics similar to polypropylene properties. Besides PHB is biodegradable and no toxic; so, it can be produced from cheap carbon sources. PHB is a homogeneous polymer, which has a solid structure that is occured by its 4-6 carbon atoms. The high crystallization rate is one more characteristic of this polymer, which arrives to 50%. The melting point of PHB depends on its solid structure and crystallization degree, which ranges from 160 - 180 m [5]. PHB-producing microorganisms are Bacillus cereus, Escherichia coli, Nostoc muscorum, Pseudomonas aeruginosa, Penicillium expansum, Ralstonia eutropha, Saccharomyces cerevisiae, Synechocystis sp., Rhizobium, Azorhizobium, Alcaligenes.

It is considered that PHB synthesis by bacterial way is more expensive than synthetic plastics manufacture, hence it is attempted to transfer it to eukaryotic cells by using yeasts as model microorganisms in PHB production. Yeasts as hosts for synthesis of PHA have advantages over bacteria. For example; yeasts have been researcehed intensively from physiology, molecular biology and biotechnology points of view. Besides, yeasts are physiologically flexible and they are enormous than bacteria. So they are preferred by many researchers [6]. S. cerevisiae is a biotechnologically significant model organism used in basic researches. Because it is a unicellular fungus, possessing a nuclear genomic DNA of 12068 kilobases organized in 16 chromosomes [7].

Presence of bacterial PHB biosynthesis genes and the improving of procedures for transmission them to eukaryotic organisms, it ought to be possible to equip higher organisms such as plants or yeasts with the ability to produce PHA [8]. Yeasts are thought to be widely used in many other areas.

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