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Review Study: Biotechnological Processes for Obtaining Polyhydroxyalkanoates and Polyhydroxybutyrate

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Abstract

This research presented a bibliographic review the means of biotechnologies to obtain polymers. The work was based on the search for natural means of achieving this achievement, since it was considered also the means of obtaining new green polymers [1]. This research, presented new ways of obtain the biopolymers in a simple and feasibly safe.

Keywords: Green polymers; Nanoparticles; Biotechnology

Abbreviations: PHB: Polyhydroxybutyrate; PHA: Polyhydroxyalkanoates; HV: Hydroxyvalerate

Introduction

Polymers are very large ones consisting of the repetition of small and simple chemical units, known as monomers, being important to emphasize that about 18% of our organism consists of proteins, which are natural polymers. The quantity of goods that surround us is enormous, produced from polymeric materials, once they are used in almost all areas of human activities, mainly in the automobile industries, packaging, coating and clothing, and themselves are incorporated is in a form permanent to our lives [2]. The method applied here in this moment, was given by citation of several works related to the theme in study, characterizing the research as qualitative approach, which according to Lakatos Marconi (1993), is based on data subjective, beliefs, values, opinions and habits. The polymers can be divided into thermoplastics, thermo sets and elastomers (rubbers) [3]. Biotechnology has several important applications in several segments, highlighting in the polymer area, since, this science has looked for alternatives for the elimination of the accumulation of materials plastics, then new studies have been developed for the purpose of manufacturing biodegradable plastic products, with costs much higher than other conventional plastics, leading to overvaluation of these polymers and the low acceptance commercial [1]. The increase in the international price of barrel of oil, the instability of the situation geopolitics of the regions holding the large world reserves and the consensus worldwide the need for development of low-emission technologies greenhouse gases, such as CO_2, have pointed to the real possibility of exploiting raw materials as renewable sources of for the biosynthesis of intermediates and of final chemicals [2].

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The PHA syntheses is a key enzyme for PHA biosynthesis, it is specificity for the substrate will define the nature of the final polymer. The first polymer of family PHA to be studied was the homo polymer Polyhydroxybutyrate (PHB), where thermoplastic properties were soon modified by the production of the Polyhydroxybutyrate copolymer and hydroxyvalerate (PHB-co-HV). The consumption of plastic products over the years has producing a large number of residues of this material which accumulate in landfills generating environmental problems considerable, the production and use of biopolymers, biodegradable polymers and green polymers appears as an alternative that, due to its technical feasibility and has a great potential of expansion. This problem leads us to carry out research on new technological means to develop biomaterials with a shorter degradation period, thus affecting to a lesser extent the environment [1]. As a general objective, the search for new biotechnological means of obtains biodegradable polymers with low cost and easy access. As a objetive specific the following stand out: research on differen tmeans of obtains ustain able polymers; new forms to obtain green polymers; search for technological processes that make it possible the recycling of the polymers manufactured.

Materials and Methods

The present research was carried out in the city of Itumbiara-GO, at ILES-ULBRA, so that more students acquired knowledge of new ways to obtain sustainable polymers and that correlate learning developed in the class room in the practice of day-to-day, in this way, the project was in its developed specificity form qualitative, since variables were studied correlating the studied subject with literature review in several works literary works. Through the need to obtain the project study, it was made a bibliographic research leading to taking in to account the experience of authors in different specificities for the different ways of obtaining green polymers, biodegradable and recyclable.

Results and Discussion

After a careful study of the project under study, it was possible to concrete way to observe the evolution the world in the development of technology and scientific knowledge on the production of polyhydroxyalkanoates and their use as a biodegradable polymer and biocompatible. New polymers are all studied all days, highlighting the Polyhydroxyalkanoates and the Polyhydroxybutyrate, being, the Polyhydroxyalkanoates arouse great interest because they are thermoplastics biodegradable, biocompatible and can be synthesized from raw materials renewable by agriculture. Their properties allow them to be used as substrates of conventional plastics, of petrochemical origin, in some applications. In general, the synthesis of PHA by bacteria in a nutritive medium occurs when there is an excess of carbon source and the limitation of at least one nutrient needed to multiply the cells (N, P, Mg, Fe), [1].

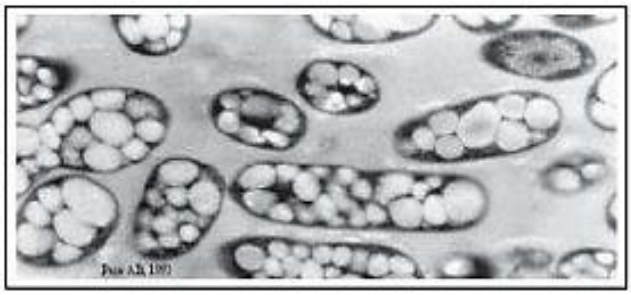

Figure 1: Bacterial cells containing biodegradable polymer granules, from the family of Polyhydroxyalkanoates (PHA) in its interior (electronic photomicrography).

In Figure 1, it is possible to observe with clarity, the formation of bacterial cells with polymer granules, these are used for the synthesis there of.

The Polyhydroxybutyrate homo polymers are composed of units of four carbon atoms. Omomentum for this study occurred at the beginning the 90's. "Production of biodegradable plastics from of sugarcane, through biotechnology "which has been developed in cooperation Laboratory of Biotechnology of the Institute of Technological Searches of SãoPaulo (IPT), the Technology Center of Coopersucar and the Institute de Ciências Biomedical Sciences of the University of São Paulo (associated with the Federal University of Paraíba), using resources from the Support for Scientific and Technological Department of the Financing Projects (PADCT-Finep). Although it is biodegradable and thermoplastic properties of the PHB homo polymer make it brittle, which limits its applications. The insertion of 3-hydroxyvalerate units (HV), composed of five carbon atoms gives the PHB-co-HV copolymer, with properties that give it greater malleability. Although there are bacterial cells able to synthesize PHB-co-HV from carbohydrates, they present low efficiency. Thus, copolymers are achieved only with the use of precursors as propionic acid. It is possible to obtain nanoparticles through preformed polymers, thus the method of preparing nano particles from preformed polymers, such as aliphatic polyesters, are particularly adapted to incorporate active principles lipophilic. Nanoparticles should be prepared on the basis of a reasonable

active/polymer suitable for obtaining a high encapsulation efficiency and toxicity [4].

In order to prepare Nano spheres by method of solvent displacement, the active principle must be dissolved or dispersed in the organic phase, together with the polymer. The preparation of Nano capsules obtaining an oily solution, formed by the active principle dissolved in oil as shown in Figure 2. It has been noticed the increase of search for renewable sources of polymers, however, the market for bio polymers, bio degradable polymers and green polymers is still incipient in Brazil, however, a production is expected in the country. Some difficulties to overcome are the level of awareness of their use polymers, which in Brazil is still very low, represents a considerable challenge, and their cost and performance compared to the conventional resins. The main applications of biopolymers, polymers biodegradable and green polymers in Brazil are in the packaging segments of food (rigid and flexible), bags and films for agriculture and consumer products.

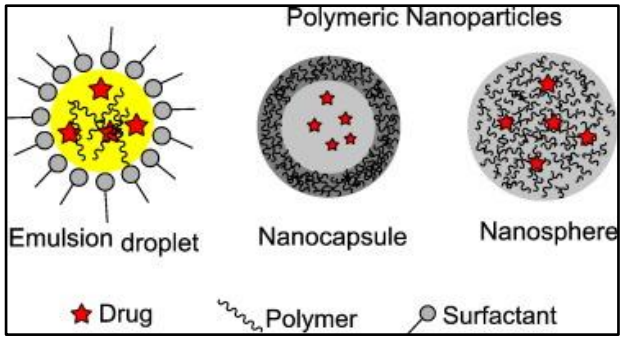

Figure 2: Schematic representation of Nano capsules and polymeric Nano spheres.

The Figure 3 shows a graph with the percentage the main applications of these polymers in the World in the year 2016 (European bio plastics, nova-institute, 2016) [5]. While, on the one hand, the polymers, biodegradable polymers and polymers green products are focused on where the biodegradability and the compos ability add a value on the other hand, the resins focus on applications where low price is required or when better technical performance (mechanical properties and thermal) is crucial [3].

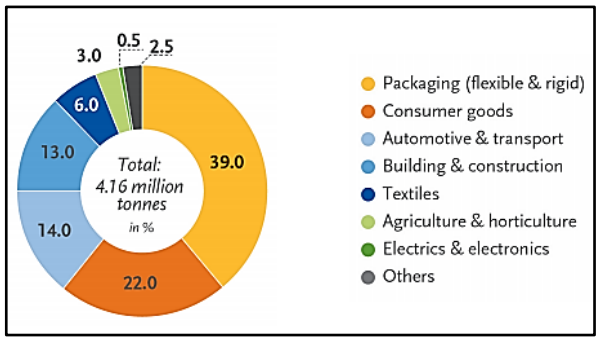

Figure 3: Main applications of biopolymers, production and capacities.

A number of uses and applications been pointed out for PHAs, with a view to their as a substitute for conventional plastics, the vast majority of the pieces made by thermoforming and injection molding, films extrudates, wires, among others, with advantage of being biodegradable in microbiologically active environments. The market for biopolymers, biodegradable polymers and green polymers is still incipient in Brazil; however, a production is expected in the country. Some difficulties to overcome are the level of awareness of their use polymers, which in Brazil is still very low, represents a considerable challenge, and their cost and performance compared to the conventional resins. Being the country the leader production of sugar cane, having the lowest cost of production of this raw material, favoring the country in production of green polymers based on ethanol [6].

Conclusion

Productions of green polymers contribute to the preservation of the environment, since it has greater degradability, greater economic profitability for requiring the use of microorganisms responsible for its bioproduction, which makes possible and justifies the reduction of production costs of the polymer.

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