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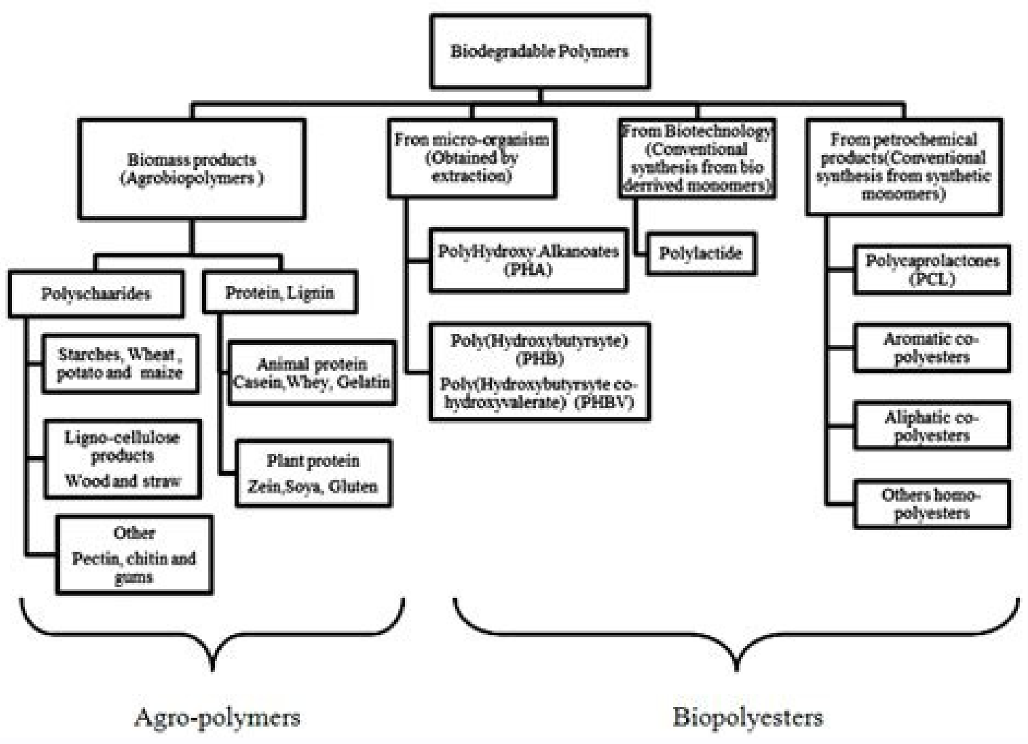

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Review

Biodegradation of Hemicellulose-Cellulose-Starch-Based Bioplastics and Microbial Polyesters

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Abstract: The volume of discarded solid wastes, especially plastic, which accumulates in large quantities in different environments, has substantially increased. Population growth and the consumption pattern of societies associated with unsustainable production routes have caused the pollution level to increase. Therefore, the development of materials that help mitigate the impacts of plastics is fundamental. However, bioplastics can result in a misunderstanding about their properties and environmental impacts, as well as incorrect management of their final disposition, from misidentifications and classifications. This chapter addresses the aspects and factors surrounding the biodegradation of bioplastics from natural (plant biomass (starch, lignin, cellulose, hemicellulose, and starch) and bacterial polyester polymers. Therefore, the biodegradation of bioplastics is a factor that must be studied, because due to the increase in the production of different bioplastics, they may present differences in the decomposition rates.

Keywords: biodegradation; bioplastics; lignocellulosic fibers; microbial polyesters

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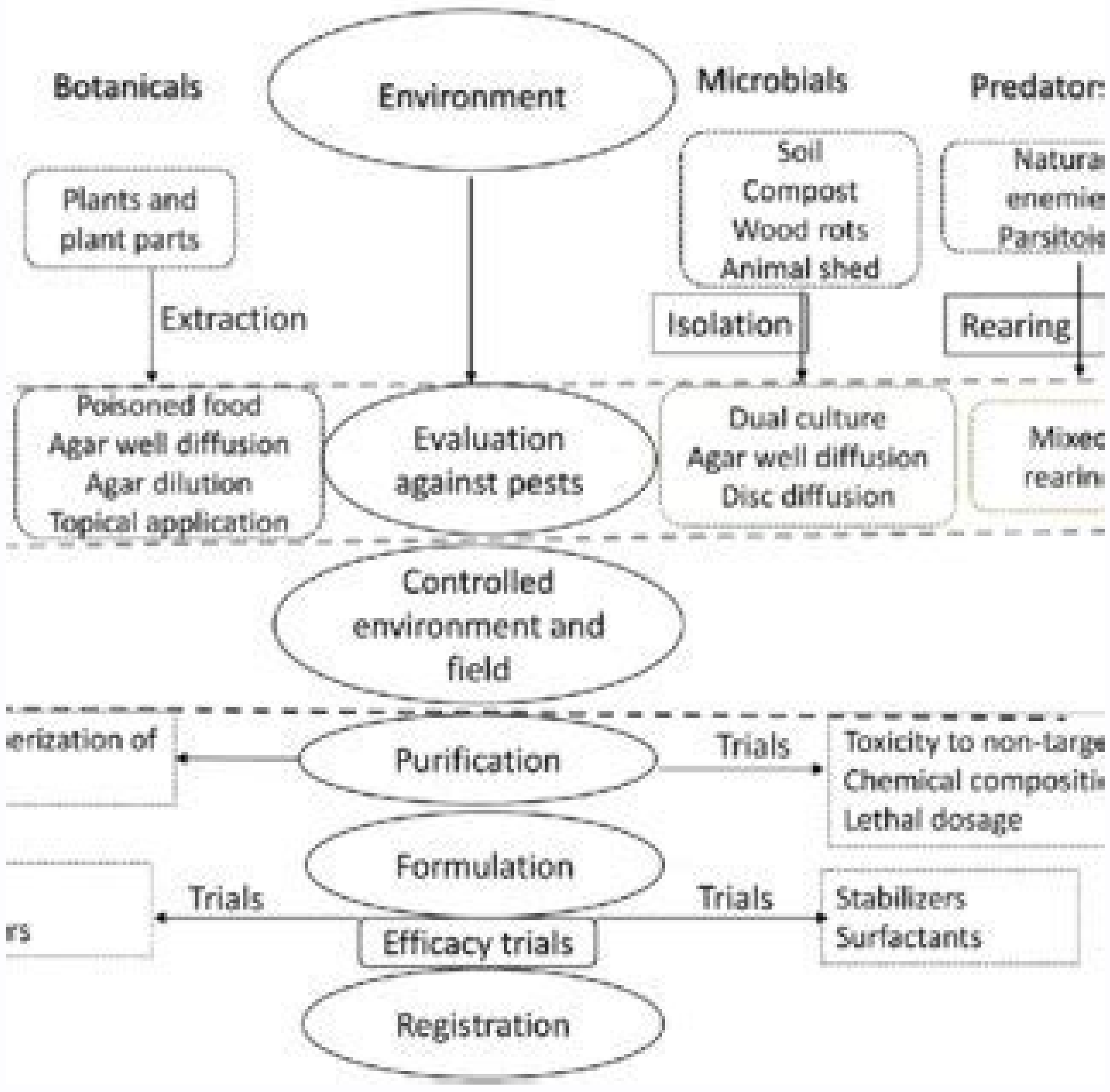
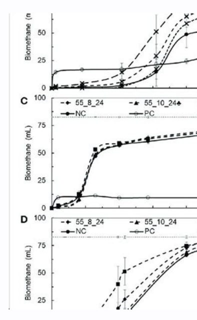
1. Introduction

Consumption demands for industrialized materials such as plastics in their various applications have increased over the past years. This consumption is generating residues, which require alternatives for their proper disposal and recycling. Disposal, recycling, and plastic substitution are potential research areas towards urgent and necessary solutions. Most commercial plastics come from the petrochemical industry, which uses natural gas and fossil hydrocarbons as feedstock. Such synthetic plastics are biodegradable and degradable only for a long period. Therefore, they are considered neither biodegradable nor renewable [1]. Synthetic polymers, such as polypropylene (PP), polyethylene (PE), polytetrafluoroethylene (PTFE), nylon, polyester (PS), and epoxy are examples of plastic components of high resistivity, chemical and biological inertness, resistance, flexibility, and other interesting properties [2–5].

At the beginning of the large-scale production of synthetic plastic materials, their properties seemed adequate for good quality development. However, such materials are non-biodegradable, thus generating large accumulations of residues in different landscapes. Thus, they have been a cause of growing concerns due to environmental problems. New materials based on biological sources have been developed towards solving or reducing the above-mentioned problems. However, in addition to be renewable and biodegradable, bioplastics must have vapors barrier properties and mechanical properties that meet the different applications of this material, and the attention has now evolved towards the possible ecotoxic effects of bioplastics and active properties for a cover of food.

The names of biodegradable and/or bioplastic products given by companies and reported in the literature, when drawn up wrongly, can lead to misunderstandings by the general public due to incorrect classifications of the polymeric materials [6–9]. A bioplastic





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Polyhydroxybutyrate (PHB) which is the first bacterial bioplastic. ^ Matet, Marie; Heuzey, Marie-Claude; Chicken, Eric; Ajji, Abdellah; AvÃÂ©rous, Luc (June 2013). doi:10.1002/14 356 007.n21_n01.pub2. (cite encyclopedia): CS1 maint: uses authors parameter (link) ^ Siracusa, Valentina; Rocculi, Pietro; Romans, Santina; Rosa, Marco Dalla (2008). A. Composites Science and Technology. Chemistry and Macromolecular Physics. 685 Â"691, doi:10.1002/ep.10 518. doi:10.1016/j.foodhyd.2016.09.023. PLA is incredibly expensive to produce and was not mass-produced until 1989. (December 1998). Generally, high amylose amide produces superior mechanical properties.[18] However, high amylose amide has less machinability due to its higher gelatinization temperature[19] and higher melting viscosity.[20] Starch-based bioplastics are often mixed with biodegradable polyesters to produce mixtures of starch/polylactic acid,[21] starch/polycaprolactone[22] or starch/Ecoflex[23] (polybutylene adipato-co-terephthalate produced by BASF[24]). doi:10.1002/j.1941-9635.2016.tb01 489. x. ISSNÂ 0091-9578. ^ Bioplastic Feedstock 1st, 2nd and 3rd Generation ^ Degli-Innocenti, Francesco. Astm.org. S2CID 213 682 035. November 2004. doi:10.1098/rstb.2008.0289. S.; Floros, Michael C.; Narine, Suresh S. doi:10.1016/j.jfoodeng.2011.04.021. Â"Life Cycle Assessments of Commercial Biodegradable Biopolymers â A Critical Review. Â"Resources, Conservation and Recycling, vol. ^ Â"Biodegradable Areas Better Plastic for the Environment?Â" February 6, 2018. ACS Sustainable Chemistry & Engineering. Withdrawal of ASTM D 6002 In January 2011, ASTM D 6002 was withdrawn, which had given plastics manufacturers the legal credibility they needed to label a plastic as compostable. ISBN 9 785 912 430 725. (Rogers 2005) 1983: the first bioplastic company, bioplastic, ...

Some bioplastics are obtained from the direct processing of natural biopolymers including polysaccharides (for example starch, cellulose, chitosan and alginate) and protein (for example soy, gluten and gelatin proteins), while others are chemically synthesized from sugar derivatives (for example acid Lactic) and lipids (oils and fats) from plants or animals, or products biologically due to fermentation of sugar or lipids. ...

Chitosan is compiled with antimicrobial activity and film that make it biodegradable and discourage deterioration growth. ... The PHB stands out mainly for its physical characteristics. ...

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S2CIDÂ, 104397987. Many plastics based on starch, plastic plastic materials and some aliphatic-aromatic co-polyester compounds, such as succins and adipates, have obtained these certificates. ^ to B Chen, Ying; Duan, Qingfei; Yu, for a long time; Xie, Fengwei (2021-11-15). Its properties are similar to those of PA 12, although greenhouse gas emissions and non-reduced resource consumption are reduced during its production. Doi: 10.18411 / D-2016-154. Note 1: Bioplastic is generally used as opposite of the polymer derived from fossil resources. "Poly (lactic acid) / composites of starch: effect of microstructure and morphology of starch granules on performance". DOI: 10.1016 / J.RSER.2009.07.020. DOI: 10.1021 / ACSSUSCHEMENG.7B00517. ISN 0079-6700. 59 (1 - 3): 245 Â ¢ â‚¬ "249. Plastics technology. ^" Bioplastics (PLA) - World Centric ". Starting from 2014, bioplastics represented about 0.2% of the world market of Polymers (300 million tons). [2] Although bioplastics are not commercially significant, the search continues on this topic. [3] An advantage for many bioplastics is their biodegradability. DOI: 10.1016 / J.Carbpol.2006.01. 026. Â ¢ â‚¬ "change emissions of use: how are the greens the bioplastics? Â, â. environmental administration and sustainable energy, vol. 16 (1): 1 Â ¢ â‚¬ "2. For example, wheat gluten and casein show promising properties as a raw material for different biodegradable polymers. [40] Furthermore, soy protein is considered as another Source of bioplasty. On the contrary, common plastic materials, such as fossil-fuel plastic (also called petroleum-based polymers) derive from oil or natural gas. 61 (1): 51 - 54. 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In addition to structural materials, electroactive bioplastics are being developed that promise to transport electricity [6]. The bioplastics are used for disposable articles, such as packaging, cookery, cutlery, vessels, bowls and straws [7]. Biodegradable plastic utensils. Doi: 10.3139 / 217.980326. DOI: 10.1016 / j.cheMol.2009.01.001. H.; Murphy, R. Bibcode: 2014Mamol..47.5135b. 2016. Biocycle can also be added plasticizers such as glycerol, glycol and sorbitol, so that the starch can also be treated thermoplastically [17]. The characteristics of the resulting bioplasty (also called "thermoplastic starch") can be adapted to specific needs by adapting the quantities of these additives. 2583Â ¢ â € œ 2591., Doi: 10.1016 / j.polymdegradstab.2013.09.018. doi: 10.1016 / j.carbpol.2016.10.037. Polyamide 11 PA 11 is a biopolymer derived from natural oil. IssnÂ, 0266-3538. ^ Pennisi, Elizabeth (1992-05-16). ^ History, Travel, Arts, Science, People, Places. Nnfcc.co.uk Recovered 2020-07-11. However, cellulosic fibers added to starches can improve mechanical properties, gas permeability and water resistance, since they are less hydrophilic than starch [26]. A group of Shanghai university was able to build a new green plastic based on cellulose through a method called hot pressing [30]. Other polysaccharide-based plastics Other polysaccharides such as chitosan and alginate can be transformed into plastic shapes. Doi: 10.1016 / j.carbpol.2021.118522. Doi: 10.1016 / j.compscitech.2020.108031. S2CIDÂ, 53569630. {{Cite Journal}}: Maintenance CS1: plus names: List of authors (links) ^ compostable.info. 97 196Â ¢ â € œ 209. doi: 10.1016 / j.progolymsci.2013.05.002. Doi: 10.1515 / spark.32.27. PmidÂ, "Properties and applications of compostable plastic based on starch". 127, Elsevier Ltd, 2016, pag. (2018-01-20). 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