MICROBIAL DEGRADATION OF POLYSTYRENE

Claudia Figueroa-Hernández, Alma Cruz-Guerrero, Miguel Reyes-Velázquez, Gerardo Ramírez-Romero
Departamento de Biotecnología Universidad Autónoma Metropolitana, Iztapalapa., Av. San Rafael Atlixco No. 186 Col. Vicentina, México D.F. 09340, México (claudiafigueroa26@gmail.coml)

Key words: biodegradation, polystyrene, Rhodococcus fascians

Introduction. Millions of tons of solid waste are annually discarded in the world, and a large proportion consists of plastics. Polystyrene (PS) is one of the most used in synthetic plastics due to its excellent thermal insulation properties (1). Biodegradation is a process where a complex molecule breaks into simple molecules as a result of the action of microorganism like bacteria and/or fungi (2). Synthetic plastics are not usually biodegradable due to the complexity of their structure, high molecular weight and hydrophobic nature (1), however, some microorganisms have the ability to degrade synthetic plastics, like polystyrene (3). The aim of the present study was to evaluate the ability of *Bacillus subtilus*, *Rhodococcus fascians*, *Pseudomonas aeruginosa*, *Micrococcus luteus* and *Aspergillus niger* on polystyrene degradation.

Methods. In order to evaluate the potential of the microorganisms on polystyrene degradation, each of the evaluated strains were inoculated in a minimum medium (MM) supplemented with PS as test medium. The same medium without inoculum was used as negative control. The cumulative CO_2 generated during four days of test was quantified by the Sturm method as propose by Pramila et al., 2012 and used to calculate the percent of degradation as establish by the OECD (4) and the percent of mineralization. Subsequently, cumulative CO_2 produced by the growth of *Rhodococcus fascians* during three months was quantified.

Results. Figure 1 shows the percent of degradation (OECD) and mineralization of each microorganism. *Micrococcus luteus*, *Aspergillus niger* and *Rhodococcus fascians* have the highest rates of mineralization (≥2%). *Rhodococcus fascians* was chosen to carry out a polystyrene degradation for three months. In this experiment, the production of CO_2 during the growth of *Rhodococcus fascians* in the MM with PS was quantified (fig. 2). It was observed that the cumulative CO_2 produced increased twice when *Rhodococcus fascians* grew in the supplemented medium. The percent of degradation (OECD) and percent of mineralization were 3.00 ± 0.33 and 6.26 ± 0.164 respectively. It was observed that the percent of mineralization previously reported for PS by the growth of a microbial consortium was 1.5 in three months (5). That confirms the potential of *Rhodococcus fascians* for PS degradation.

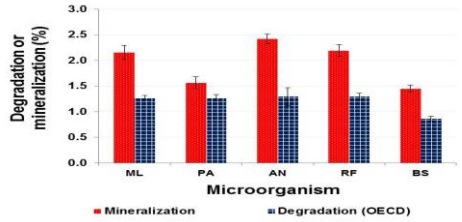

Figure 1 Percent of degradation and mineralization of evaluated microorganisms. ML= *Micrococcus luteus*, PA= *Pseudomonas aeruginosa*, AN= *Aspergillus niger*, RF= *Rhodococcus fascians*, BS= *Bacillus subtilus*

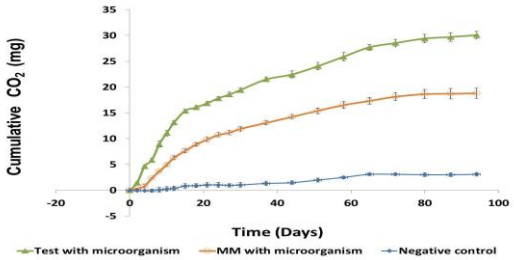

Figure 2 Cumulative CO_2 (Sturm test) produced by the growth of Rhodococcus fascians during three months in MM supplemented with PS

Conclusions. The evaluated strains have the ability to use PS as a carbon source. *Aspergillus niger, Micrococcus luteus* and *Rhodoccocus fascians* showed the highest degradation rates. The percent of mineralization over three months of incubation with *Rhodoccocus fascians* was 6.26 ± 0.164.

Acknowledgements. This work was supported by Centro Nacional de investigación y capacitación Ambiental (CENICA) de la SEMARNAT.

References.

1. Atiq, N, Ahmed, S, Andleeb, S, Ahmad, B, & Robson, G. (2010). *Afr. J. Microbiol. Res.* 4(14):1537-1541
2. Pramila, R, Padmavathy, K, Ramesh, K, & Mahalakshmi, K. (2012). J. Bacteriol. Res. 4(1): 9-14
3.Gu, J. (2003). *Int. Biodeterior. Biodegrad*. 52:69-91
4.OECD (1992).OECD Guideline for testing of chemicals. 301 B CO_2 Evolution test
5.Ojeda, T, Freitas, A, Dalmolin, E, Dal Pizzol, M, Vignol, L, Melnik, J, Jacques, R, Bento, F & Camargo, F. (2009). *Polym Degrad Stabil*. 94(2128-2133)