EUROPEAN COOPERATION IN SCIENCE AND TECHNOLOGY

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Short Term Scientific Mission (STSM) 2013

# How to Characterize Bacterial Plastics?

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## Objectives

The main objective was to study the extraction procedure and also to perform the characterization of the polyhydroxyalkanoates (PHAs) produced by mixed microbial cultures.

## Methodology

Several experiments were performed in the University of Santiago de Compostela in order to evaluate the influence of the operational conditions and substrate composition in the storage process of different biopolymers. In order to complete this study, the biopolymers produced with each substrate needed to be characterized in terms of molecular weight and other physical properties. The techniques included nuclear magnetic resonance (NMR), differential scanning calorimetry (DSC) and size exclusion chromatography (SEC).

## Results

The films of this work were analysed by $^1$H-NMR. This helped to identify the HB:HV ratio in the plastic film and also to observe the presence of other molecular groups different to the ones related to 3-HB and 3-HV. The molecular weight was determined by SEC.
DSC was used in order to know thermal properties like the Glass Transition Temperature ($T_g$) and the Melting Point ($T_m$) (Table 1).

**Table 1.** Physicochemical obtained results.

| Sample | HB:HV ratio (g HB/g HV) | $T_g$ (ºC) | $T_m$ (ºC) | | $\Delta H_m$ (J/g) | | $T_d$ (ºC) | Crystallinity (%) | $M_w$ (g/mol) | PDI |
|---|---|---|---|---|---|---|---|---|---|---|
| VFAs | 1.63 | -7.65 | 102.0 | 158.8 | - | 5.7 | 250.0 | 3.9 | $1.2 \times 10^5$ | 1.6 |
| HAc | 21.2 | -6.63 | 145.4 | 161.4 | 5.3 | 39.6 | 237.2 | 24.0 | $8.7 \times 10^4$ | 1.5 |
| HPr | 0.52 | -21.04 | 91.7 | n. d. | 55.6 | n. d. | 240.4 | 10.5 | $1.5 \times 10^5$ | 1.6 |
| 50/50% v. HAc/HPr | 0.79 | -12.40 | 105.0 | n. d. | 3.4 | n. d. | 226.3 | 2.3 | $1.4 \times 10^5$ | 1.5 |
| VFAs 8.5 g $Na^+$/L | 2.60 | -5.20 | 103.3 | 166.7 | 6.5 | 9.7 | 256.2 | 6.7 | $2.0 \times 10^5$ | 1.3 |
| 02.05 (purified) | 17.52 | 5.26 | 165.2 | n. d. | 72.5 | n. d. | 270.6 | 50.1 | $8.7 \times 10^4$ | 1.3 |
| 07.05 (purified) | 0.76 | -11.01 | 94.8 | 104.6 | 31.6 | n. d. | 269.4 | 18.4 | $1.4 \times 10^5$ | 1.8 |

## Highlights

This STSM was very fruitful in terms of training and learning but it was also very useful in terms of multilateral collaborations and transfer of outcomes. This is because making contact with the Biochemical research group of the University of Nova Lisboa (Portugal) spread our working network because this group is specialized also in the bioplastic topic and they do the extraction and characterization of the biopolymers, which was the main objective of the STSM.
After all this work carried out during 3 months at Universidade Nova de Lisboa, the publication of one article is feasible. Other works will be probably held together in the next future.

Earth System Science and Environmental Management (ESSEM)

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