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Evaluation of Electrospinning Parameters in Polyhydroxyalkanoates

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Polyhydroxyalkanoates (PHA) are biopolymers known for their biocompatibility and biodegradability, making them attractive for sustainable and biomaterial applications. Its properties vary according to the composition. For instance, poly-3-hydroxybutyrate (PHB) is recognized for its rigidity and low flexibility. On the other hand, poly-3-hydroxybutyrate-co-hexanoate (PHBHHx), depending on the HHx content, may present a large elongation. Its applications include tissue regeneration, packaging, and filtration membranes. The electrospinning technique is performed by feeding a polymer solution through a syringe needle, forming a drop at the tip. An electric field between the needle and a metallic collector induces a charge in the drop, which is aesthetic and narrows into the so-called "Taylor cone". Under ideal conditions, the ejected solution forms a continuous fiber that deposits in the collector. This stands out for the production of nanostructured and customizable materials, by controlling technical parameters such as solution concentration, flow, needle-collector distance and tension. This study aims to characterize PHB and PHBHHx electrospun membranes with different HHx contents (2 and 6%). Solutions were prepared by solubilizing 4 wt% of polymers in chloroform and dimethylformamide solution (8:2 vol). The parameters included flow (1 and 0.7 mL/h), distance (15 and 20 cm), and voltage (10, 15, and 20 kV). Temperature and humidity were maintained at 25ºC and 50%, respectively. Using scanning electron microscopy (SEM), images of three different regions were used to make 60 fiber diameter using ImageJ software. In general, no beads were observed on the tested parameters. The tension increase demonstrated an improvement in the average diameter of the fibers, associated with an increase in the standard deviation, which reveals fiber irregularity. On the other hand, when increasing the distance, there was a tendency to reduce the diameter and standard deviation of the fibers, showing that smaller distances can contribute to the solution and charge stabilization, resulting in greater uniformity of the fibers. No significant changes were observed in the samples studied when changing the flow from 1 to 0.7 mL/h. Future investigations will include the use of the copolymer with higher concentrations of HHx, in addition to the evaluation of other parameters, such as solution concentration. Finally, consistency and conductivity measurements of the solutions will be carried out to correlate the results obtained.