Biodegradability and disintegration of bio-based materials produced with DHT-modified cassava starch

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The development of biodegradable plastics is one of the promising solutions to inadequate waste management practices. Among the different types of biopolymers, starch is massively used to produce these types of materials. However, is well-known that native starches' performance is limited, and the properties of their plastics are not competitive against conventional ones, yet. Among the different types of starch modifications to increase its performance, the dry heating treatment (DHT) is a technique that was proven to enhance the mechanical and barrier properties, mainly related to molecular depolymerization and carbonyl group formation. However, is not described the effect of this type of modification on biodegradability and disintegration behavior. In fact, in the literature, the polymer structure, polymer chain length, and functional groups influence the degradation pattern. Obtaining materials with increased performance is a good achievement, though, those materials must result also in proper rates of degradation, if not the principal problem of plastic waste contamination will not be solved. Therefore, this work aimed to produce bio-based plastic with cassava starch previously modified by dry heating treatment (DHT) and study its disintegration and biodegradation.
Native cassava starch was modified by dry heating treatment (DHT) for (2 and 4) h at 130 °C. Then, bio-based sheets (native and modified) were produced by extrusion in a twin-screw extruder (Thermo Fisher Scientific, Process 11, Germany) with L/D 40, and 11-mm screw diameters. The film disintegration assay was performed for 45 days at 58 °C according to EN ISO 20200, while biodegradation was in accordance with ISO 14855-1. Furthermore, samples of materials were evaluated at different control times to monitor sample weight loss, morphological and mechanical changes, and FTIR spectra.
The main results showed that all the materials showed up to 80 % and 90 % of biodegradation and disintegration, respectively. Moreover, higher rates of both were visualized until day 7, which matches with the microbial growth and disappearance of functional groups. In particular, the DHT4 sheet showed higher rates, which is a great achievement, because DHT4 showed enhanced plastic performance and through this study was proved that also the disintegration and biodegradation process.