Mechanical Properties of PETG vs. PHBHHx for Clear Aligner Application

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This study investigates the effects of environmental temperature fluctuations and ultrasonic cleaning on the mechanical properties of two polymers: polyethylene terephthalate glycol (PETG) and poly(3-hydroxybutyrate-co-3-hydroxyhexanoate) (PHBHHx). PETG is widely used in orthodontic aligners due to its favorable mechanical properties and transparent aesthetic. However, its widespread use and disposal contribute significantly to plastic pollution and may pose health concerns if not properly sterilized. PHBHHx, a biodegradable polymer, exhibits mechanical and structural characteristics similar to PETG, making it a potential sustainable alternative for clear aligner production. To simulate hygiene practices, standardized samples of both polymers were subjected to ultrasonic cleaning to model routine cleaning cycles. Additional samples underwent thermal cycling between warm and cold temperatures to replicate the consumption of heated and cooled beverages. Mechanical properties were evaluated by measuring Young's modulus and tensile strength before and after treatments using a PASCO Comprehensive Materials Testing System, with data analyzed in PASCO Capstone, R Studio, and Microsoft Excel. Results indicate that PHBHHx has lower initial Young's modulus and tensile strength than PETG and is more sensitive to sonication. However, during thermal cycling, PHBHHx showed smaller reductions in stiffness and strength than PETG, suggesting greater resistance to heat-related degradation. Statistical analysis supports that material type and treatment significantly affect mechanical behavior. While further optimization is needed to improve its overall strength, PHBHHx's biodegradability and relative thermal stability indicate potential as a sustainable alternative for clear aligners.

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