Development of Seaweed Bioplastics to Alleviate Environmental Plastic Pollution

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At least 14 million tons of plastic, half being single-use items, pollute the environment each year. Most of this plastic is petroleum-based and can take up to 1000 years to degrade. This project aimed to alleviate this waste and pollution by developing a novel alternative to petroleum plastics: macroalgae bioplastics. Prototype bioplastic cups were made from Alaskan Nereocystis luetkeana and East Coast Ascophyllum nodosum. A cup made from agar agar, a seaweed biopolymer, served as the control. Prototypes were initially tested for durability and permeability, characteristics that determined the success or failure of each product. The prototypes' biodegradability was then assessed by submerging the prototypes in solutions of the enzyme alpha amylase. Data were analyzed using a Chi-square goodness of fit test and a two-tailed t-test respectively. During functionality assessments, N. luetkeana proved the more consistent feedstock for product development (100%) compared to both A. nodosum (33%) and agar agar (66%). In terms of biodegradability (average percent weight loss) agar agar (48.4%±6.1) was more biodegradable than both A. nodosum (48.2%±10.0) and N. luetkeana (39.5%±2.2). Statistical analysis showed no significant difference in biodegradability of N. luetkeana and A. nodosum prototypes when compared to agar agar ($p=0.8$ and $p=0.1$, respectively). This study suggests that N. luetkeana has high potential for use in bioplastic products despite being somewhat less biodegradable than A. nodosum. Future research could further develop these prototypes into increasingly economically feasible products for application in our society.