A Prickly Project: Extracting and Quantifying Oxalate Concentrations in Opuntia engelmannii

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The unique carbon fixation and CAM photosynthesis process of Tucson, Arizona's Opuntia engelmannii (Texas prickly pear) offers reduction to the ever-rising carbon dioxide atmospheric levels; however, the variability among prickly pears' CO_2 fixation capabilities remains unknown. Since the oxalate ($C_2O_4^{2-}$) reserves in Opuntia engelmannii are directly converted from CO_2 extracted from the atmosphere, the goal of this research was to construct a reproducible assay to quantify the amount of oxalate in prickly pear paddles (cladodes) and by extension quantify the level of carbon fixation within each cladode. As a result of intense experimentation and optimization to the overall assay and individual steps within it, an assay with 8 core steps — including manual extraction of calcium oxalate from cladodes, chemical isolation of oxalic acid, and an oxalic acid-sodium hydroxide titration — was developed from scratch. The effectiveness of the assay was confirmed by the results of Sample 2, Sample 1', and Sample 2': 0.106%, 0.102%, and 0.132% respectively. Although all 3 samples measured similar percentages, the data set was too small to draw conclusions about true oxalate variability, so the real significance of these results were reflected by their completion and dual-equivalence titration curves which served as a proof of concept. In conclusion, this assay provides a great foundation for future investigation of a possible correlation between environmental conditions and oxalate concentrations in texas prickly pear. Certain environmental conditions can then be fostered by individuals to allow prickly pear to maximize oxalate concentrations and by extension maximize CO_2 fixation.

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