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Project title:
From fragile to functional: Tailoring cellulose films by systematic blending

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Abstract (approx. 200 words)**:**
Plastic waste is projected to triple from 353 million to over 1 billion tonnes by 2060. Flexible packaging is a major plastic waste contributor due to its short lifespan of only six months from production to disposal. Renewable cellulose films are promising biodegradable alternatives to traditional polyolefin films in packaging and other applications. Cellulose films, however, lack certain properties such as elasticity and gas impermeability which are essential for many applications. Film elasticity can be improved by using plasticizers, yet the potential to fine-tune film properties through specifically designed plasticizer blends remains largely unexplored. Here, we plasticized regenerated cellulose films with simple polyol blends prepared using glycerol, sorbitol and maltitol. We then developed statistical models for key film properties based on blend composition and integrated these models to optimize mechanical film properties and barrier performance. Our optimized plasticizer blends improved film strength and gas impermeability by 50-90%, outperforming their commercial cellophane reference. Our data-driven methodology could thus offer a robust and scalable tool to tailor the properties of cellulose films based on plasticization. The approach paves the way for using mathematical models to design cellulose properties for specific applications, but requires a more fundamental understanding of the underlying mechanisms of cellulose plasticization. Our future research will focus on unravelling cellulose-plasticizer interactions to improve regenerated cellulose films for packaging and other applications.

Short bio of the person: Pauliina Ahokas is a research scientist at VTT and pursuing towards a doctoral degree at Aalto University. Her work focuses on developing renewable alternatives to conventional plastics, for example, by improving the elasticity and barrier properties of regenerated cellulose films in packaging and other applications.

References:
Ahokas et al. “Plasticizer Mixing Improved Regenerated Cellulose Films as an Alternative to Plastics,” ACS Sustainable Chem. Eng. 2025, 13, 28, 10771–10779.

Key words:
cellulose films, mixture design, tensile strength, permeability, regression modelling