Optimizing Biologic Paint Drying Time With Cellulose Nanocrystals and Chitosan Additives: Benchmarking Against Commercial Paints - Year 4

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Purpose: Conventional paints pose significant health and environmental hazards due to heavy metal presence and volatile organic compound emissions, necessitating safer alternatives. I previously developed biologically derived paint using dsRED protein pigment from genetically engineered Escherichia coli and casein binding medium, but its drying time (16 minutes) was longer than commercial paints (1 min). This study evaluates cellulose nanocrystals (CNC) and chitosan as natural additives to address this limitation. Procedure: Biologic paint with CNC and chitosan additive (2%, 5%, and 10% concentrations) were compared with biologic, casein, and standard paints. Drying times were measured using touch-dry method and filter paper test. Results: The baseline biologic paint dried in 12.96±1.07 min compared to standard paint in 1.13±0.18 and casein paint in 1.31±0.25. The addition of CNC at 2%, 5%, and 10% concentrations significantly reduced drying time to 10.21±1.22 ($p<0.01$), 7.52±0.69 ($p<0.01$), and 5.03±0.40 ($p<0.01$), respectively. The addition of chitosan at 2%, 5%, and 10% reduced drying time to 11.77±0.55, 9.40±0.97, and 7.23±0.99, respectively; decrease was significant at 5% ($p<0.01$) and 10% ($p<0.01$), but not at 2% ($p=0.15$). Drying time of biologic paint with both additives decreased linearly; CNC (-0.77 min/1%) demonstrated a significantly steeper slope than chitosan (-0.58 min/1%) ($p<0.05$). Conclusion: These findings demonstrate that biologic paint with CNC or chitosan achieves substantial drying time reductions, nearing commercial benchmarks. This safe, sustainable, and eco-friendly innovation presents a promising alternative to commercial paints.

Awards Won: