Warren J Grigsby et al., J Material Sci Eng 2015, 4:4
http://dx.doi.org/10.4172/2169-0022.S1.022

OMICS International
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International Conference and Exhibition on
Biopolymers & Bioplastics

August 10-12, 2015 San Francisco, USA

Greening Plastics: Modifying plastics with functional additives based on condensed tannin esters

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Substituting synthetic plastic additives with bio-derived materials has potential to improve plastic sustainability credentials. Esterified and native condensed tannins from Pinusradiata bark have been explored as functional plastic additives in petrochemical and biodegradable plastics. The presence of longer alkyl chain hexanoate esters promoted tannin miscibility in plastics whereas short chain acetate esters tended to remain as discrete domains, acting as fillers in the processed plastics. The presence of tannin esters at typical plastic additive loadings did not alter plastic mechanical properties, but greater (up to 10%) loadings can reduce both flexural and tensile properties. In assessing the functional equivalence provided by tannin additives, it was demonstrated that tannin esters inhibit the effects of UV and oxidative degradation. In polypropylene the use of tannin hexanoate acetate had greater UV inhibition efficacy than a typically used synthetic UV stabiliser at comparable loading. The tannin-additives likely provide a stabilising role through inhibiting UV penetration into the plastic, with analysis suggesting the tannin moiety itself was sacrificial and preferentially degrading. The degree of tannin esterification and retention of antioxidant capacity was crucial to inhibiting oxidative degradation and reducing plastic aging. Soil composting also revealed the tannin esters do not impact degradation of biodegradable aliphatic polyesters.

Biography

Warren J Grigsby is a Researcher Leader at Scion (New Zealand) with research activity spanning synthetic and polymer chemistry applications of biopolymer systems. He is leading the development of bio-based adhesive and polymer systems that can be used as substitutes for chemicals derived from petroleum. He has a lead role in the direction and coordination of innovative research efforts in both commercial and government-funded research. His current research activities include the synthesis of biobased adhesives and resins for use in engineered wood products and high performance composites, novel wood modification processing strategies, and adapting polyphenolics in a range of applications.

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