SMALL LACCASE – CATALYSED SURFACE FUNCTIONALISATION OF COCONUT FIBRES AND CHITOSAN FOR THE DEVELOPMENT OF FUNCTIONAL MATERIALS WITH ANTIMICROBIAL PROPERTIES

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INTRODUCTION

Laccase-mediated functionalisation is a versatile approach which can be used to graft phenolic compounds onto biomaterials to impart different functionalities such as antimicrobial, hydrophobicity, tensile strength or mechanical properties (Fillat et al., 2012). Biomaterials such as coconut fibres (CF) and chitosan (CHS) are ideal substrates for functionalisation due to the presence of reactive sites on lignin rich (40-45%) coconut fibres (Thakur et al., 2015) and hydroxyl and amine groups on chitosan (Dash et al., 2011).

At the same time suitable functional molecules can be oxidised by laccase to facilitate grafting through radical-radical coupling onto the oxidised lignocellulose surface (Fig. 1). Modifying these biomaterials by environmentally friendly methods such as enzymatic methods is a great alternative to harsh and hazardous chemical methods (Witayakran and Ragauskas, 2009). Furthermore, unlike enzymatic approaches, chemical processes require proper handling and disposal procedures thereby increasing the cost of the end-product (Kalia et al., 2013).

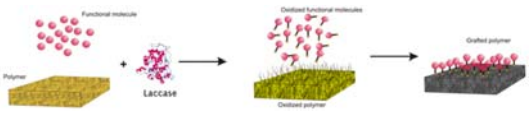
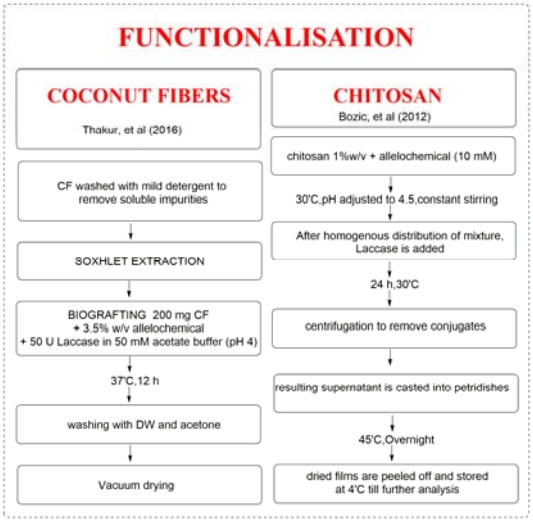


Fig. 1. Schematic diagram of laccase-catalysed grafting reaction

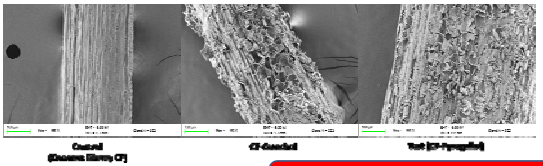
METHODS

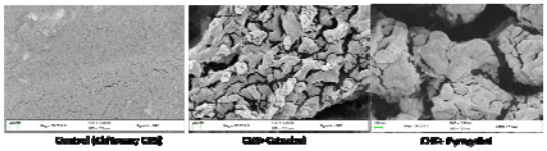


COCONUT FIBERS

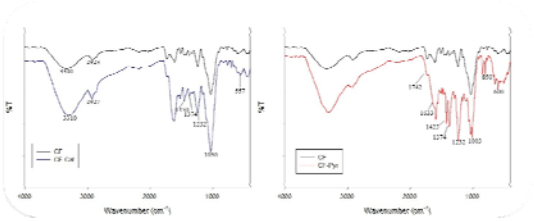
CHITOSAN

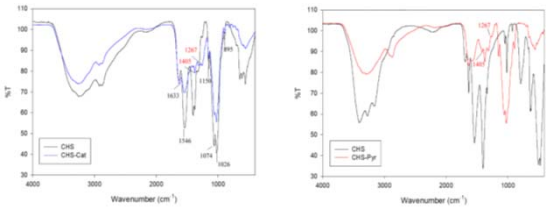
SCANNING ELECTRON MICROSCOPY



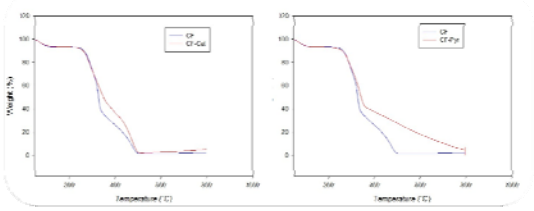


INFRARED SPECTROSCOPY

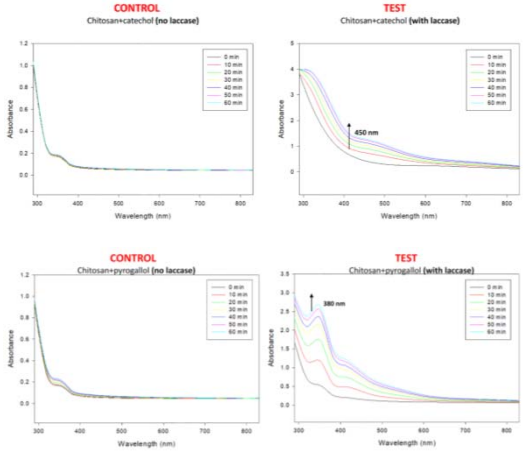




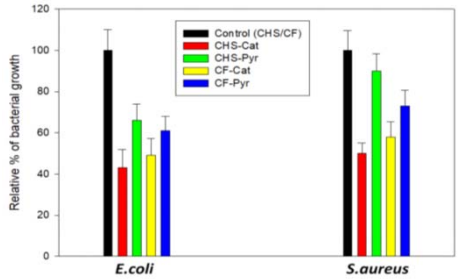
THERMAL GRAVIMETRIC ANALYSIS



UV – VIS SPECTROSCOPY



ANTIBACTERIAL ACTIVITY



HIGHLIGHTS

- A low redox potential bacterial laccase was used in the functionalisation of coconut fibres and chitosan.
- Coupling of o-quinones with lignin moieties (of coconut fibres) and amino groups (of chitosan) is detected by several techniques.
- Antibacterial activity of allelochemicals is successfully transferred to coconut fibres and chitosan films.
- This upgrade in the surface characteristics can find its use in packaging (chitosan conjugates) as well as in reinforced composites (CF- conjugates).

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