



INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

The increasing demands for safe and healthier food products have led to the development of novel packaging technologies that protect the globe from hazards arising from fossil-based non-biodegradable food packaging material. In this regard, renewable bio-based and biodegradable plastics produced by economically viable industrial processes can be considered and utilized as sustainable plastic food packaging material. Besides, the whole world is combating the crucial problem of post-harvest losses of fresh produce, wherein India is facing a 30-40% loss due to post-harvest. In this context, novel packaging technologies in the form of edible film and coating as a preservation technique can provide an alternative solution to protect post-harvest fresh produce. In the present work, the development of sustainable primary food packaging material in the form of edible films and coating is studied and characterized for various physicochemical, biochemical, and microbial properties. Also, the developed edible coating formulation is applied to food systems (green chili, tomato, onion, and potato) to check the effectiveness of the coating. The storage study of the coated fresh produce has been conducted at room temperature to determine the effectiveness of coating on the quality and shelf-life extension of the produce and to draw a comparison against the uncoated. Among the variety of edible biopolymers, chitosan, and guar gum have been utilized in this work. Further, targeting to develop active edible

packaging and tuning the inherent properties of these edible biopolymers for obtaining better effectiveness, natural food additives such as green algae extract, and essential oil is added. Algae is an emerging biomaterial, predominantly used for biodiesel production by utilizing its oil. It is used in the pharmaceuticals and food industry. However, the residue of algae biomass after oil extraction is treated as waste either used as cattle and aqua feed or dumped as waste. Interestingly, this industrial bio-based waste can be utilized as a whole or by extracting its bioactive compounds and can be incorporated into the biopolymer to obtain effective properties. The green algae biomass residue has been utilized and the extract is added to the edible packaging formulation for enhancement of barrier, physicochemical, antioxidant, antimicrobial, and other characteristics properties which are necessary for food packaging. Besides, sustainable bio-composites have been fabricated with the incorporation of cellulose nanocrystal biomaterials extracted from algae biomass residue for the development of secondary packaging material. In this context, Poly(lactic acid) (PLA), and Poly(ϵ -caprolactone) (PCL) have been utilized in order to develop secondary packaging, which is one of the most widely studied sustainable polymers that possess several properties that are comparable to conventional polymers. The developed biodegradable bio-composites are studied in detail for crystalline behavior and migration properties. Active agent curcumin is deliberately added to the bio-composites to study the effect of nanostructured material on the migration behavior of active compounds. The active secondary food packaging material is further applied to food systems to understand the effect of packaging material. Further, a cytotoxicity test has been performed on all the developed packaging materials for understanding the non-toxicity and biocompatible nature. Overall, in this thesis, an alternative pathway for extending the shelf-life of perishables using edible coating technology has been reported and it has also demonstrated the capability of utilizing algae biomass waste for the fabrication of primary and secondary food packaging material. Also, this thesis work provides the first step in the utilization of algae biomass for the development of primary active packaging material.