Thesis Title: Development and Characterization of Starch Based Biodegradable Films for Food Packaging

Submitted by: Chandani Sen

Roll No: 12AG92R04

ABSTRACT

Alarming environmental pollution from petroleum based non-biodegradable disposable packaging films has generated concern for development of alternatives from natural polymers such as starch. Most of the previous research works supplemented starch with polyvinyl alcohol (PVA) in amount higher than that of starch, and crosslinking agent glutaraldehyde (GA) for improvement in properties. Considering the limitation of petroleum resources, the aim of this work was to optimize blend composition using corn starch (CS), low amount of PVA, and GA to produce self-supporting flexible packaging film with maximum tensile strength (TS) and elongation (El), and minimum water vapor permeability (WVP), using response surface methodology. Following optimization, antimicrobial(s) like benzoic acid (BA), potassium sorbate (PS), and sodium propionate (SP) were added in the optimized blend; the antimicrobial that produced desirable film properties was selected. The developed antimicrobial containing self-supporting film (SSAF) was then characterized in the light of physical, mechanical, optical, structural, thermal, and moisture sorption properties. Food packaging applicability was evaluated on shelf life of fresh fruits and bread. The extent of biodegradability and its effect on soil quality was also investigated.

The developed films, irrespective of compositions, were self-supporting, easy to handle, and flexible. The optimum blend composition (g/100 ml) that produced film with maximum TS (11.66 MPa) and El (8.56%), and minimum WVP (0.132 $g.mm.m^{-2}kPa^{-1}h^{-1}$) was 7.50 (CS), 0.875 (PVA) and 0.125 (GA). The most suitable antimicrobial was SP at a concentration of 1.791g/100 g polymer (comprised of CS and PVA). SSAF, tagged with appropriate tensile strength (13.38±0.33 MPa), elongation (22.90±0.77%), crystallinity (27.75%), surface roughness (0.016-0.026 μm), brightness (73.60%) and opacity (5.35±0.03%), justified its use as food packaging material. Its water absorbing capacity coupled with WVP (0.160 $g.mm.m^{-2}.kPa^{-1}.h^{-1}$) helped to maintain the proper condition to extend the storage life of packed foods, over commercially used packaging film. Embedded with antimicrobial, SSAF also helped to resist microbial attack of the contained foods during storage. Over 90% biodegradation of SSAF was achieved within 28 days. Biodegradation of buried film improved the quality of soil with a higher level of available nutrients.

Keywords: Self-supporting antimicrobial film; biodegradable packaging material; corn starch; characterization; food packaging