ABSTRACT

Gelatin, a proteinous polymer of animal origin has been chemically modified by condensing it with trimethylolphenol to a crosslinked network. The modified gelatins have been characterized in respect of their physical, thermal and mechanical properties. Their biodegradability under soil burial tests and also by the specific strains of microorganisms, namely *Aeromonas hydrophila*, PC5 and LA8, has been studied. Additionally, trimethylolphenol, the modifier reagent used for crosslinking gelatin, has also been synthesized and characterized in respect of its, chemical identity, purity, and its chemical reactivity towards self-condensation.

Primary objective behind undertaking the work was to develop a suitable method to upgrade gelatin wastes by chemical modification to useful end products. As such, only about 50% of the gelatins extracted from mammalian bones, hides, and skin are commercially useful, the rest being discarded as waste or useless. The chemical modification method chosen and adapted in this studies is of crosslinking. The reagent chosen is trimethylolphenol, a member of the phenol-formaldehyde class of resins, which offers the advantages of having the smallest molecular mass, highest reactivity and functionality per phenol moiety and of being highly soluble in water for a molecular level mixing with gelatin substrates in aqueous medium.

Results show that even a small proportion of trimethylolphenol can very efficiently crosslink gelatins and thereby imparts greatly enhanced resistance to swelling by water, improved thermal stability and superior tensile properties to the modified gelatins. The modified gelatin-trimethylolphenol blends have also been found to be quite resistant to biodegradation by nonspecific strains of microorganisms in local soil at room temperature, but can be totally biodegraded by specific strains of *Aeromonas hydrophila*, PC5 and LA8 in neutral (acid-base) medium and temperate environments.

In regard to the application potentials of these modified gelatins it is envisaged that the products will have high environmental stability under normal indoor aerobic

usage conditions. Yet, they would be totally biodegradable when disposed off into the soil. One of the possible application of the modified gelatins is as a coating material onto cellulosic substrates, to which they are likely to impart strong adhesion to the substrate, high surface gloss and resistance to mechanical wear and tear, together with reduced moisture/water retention. The modified gelatins have some inherent drawbacks : they are to some extent brittle and have light yellow to brown colour.

Use of plasticizers for gelatins, has therefore been suggested, and efficiency of polyoxyethyleneglycol of MW ~400 (PEG 400) has been tested in this investigation. Results show that PEG 400 can permanently bind itself onto the modified gelatin matrix, and is capable of offering both a substantial degree of plasticization and a considerable mechanical reinforcement to the matrix.

Some specific applications of the trimethylolphenol modified gelatins are as coating of agricultural paper mulch, coated paper packaging for food materials, protective and attractive coating for book covers and binders for match-stick heads.