Lactic Acid – A Renewable Resource for Biopolymers

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Biodegradable polymers are used in an increasingly large number of mass produced applications such as packaging, paper coating, fibers, films, and other disposable articles, as well as in biomedical applications such as resorbable surgical sutures, implants, and controlled drug delivery devices. Particularly in the packaging sector, the raw materials should be annually renewable and the end products should be compostable to reduce the use of fossil resources. Furthermore, the production processes on an industrial scale should be efficient, environmentally friendly and economically competitive. Among possible monomers, lactic acid (2-hydroxy propionic acid), which is a non-toxic, naturally occurring, and renewable raw material, fulfills most of these rigorous requirements. Pure L- and D-lactic acid can be obtained by fermentation or culture techniques, whereas synthetic lactic acid is a racemic mixture, referred to as DL-lactic acid. There has been a continued interest in more efficient process for fermentation production of lactic acid, its recovery and purification. The traditional recovery process of lactic acid from fermentation broth is quite complicated. Reactive extraction with a specified extractant has been proposed as a promising technique for the recovery of lactic acid.

Lactic acid based polyesters are well known and widely studied biodegradable polymers. Poly(lactic acid), a thermoplastic polyester, is suitable for packaging applications, since PLA's glass transition temperature (Tg about 60°C) is above the service temperature. The existence of both a hydroxyl and a carboxyl group in lactic acid enables it to be converted directly into polyester via a polycondensation reaction. The most common way to obtain high-molecular-weight poly(lactic acid) is through ring opening polymerization of lactide. An alternate way to achieve high-molecular-weight polyesters is to treat condensation polymers with chain extenders. Hydroxyl-reactive chain extenders can be more effective in increasing the molecular weight.

This paper mainly focuses and gives a state-of-the-art review on various techniques to produce lactic acid, its recovery from fermentation broths, and its application in biopolymers. It will also cover recent polymerization techniques to get high-molecular-weight biopolymer, which has got tremendous applications.

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