High molecular weight Poly(L-Lactic acid)s and their copolymers by polycondensation: Is it Possible ?

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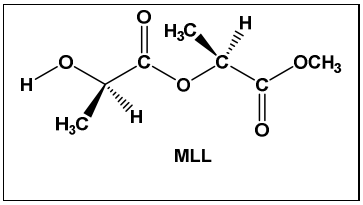
Poly(L-lactic acid)s (PLLA) in the useful molecular weight range are best synthesised by ring opening polymerization (ROP) of L-Lactide. In spite of being the method of choice, both in the laboratory and in industrial processes, ROP has many limitations. The cyclic lactide is relatively expensive and is incompatible for copolymerization with many α,ω-hydroxy carboxylic acid esters. Consequently, only those monomers which can polymerize by ROP have been copolymerized with L-lactide [1].

It would be, therefore, useful to have a monomer for PLLA capable of undergoing linear polycondensation. L-lactic acid is available only as an aqueous solution and is difficult to polymerize. Methyl-L-lactate is available in a non-aqueous form [2]; however, its low boiling point precludes its utility as a co-monomer. Furthermore, linear polycondensation of poly(L-lactic acid)s by dehydrative polycondensation is beset with the problem of formation of cyclic oligomers [3].

To re-examine this question, we undertook the synthesis of a model dimer, namely, 1-methoxy-1-oxopropan-2-yl 2-hydroxy propionate, or methyl lactyllactate (MLL) by cross esterification of L-lactic acid with L-methyl lactate.



MLL

This dimer has no free acid group and can be obtained as a high boiling liquid (b.p. 252.5^{0}C at 760 mmHg). The synthesis of MLL, its structural and compositional characterization and its polymerization behaviour will be presented.

References:

[1] Rafael A. Auras, Loong-Tak Lim, Susan E. M. Selke, Hideto Tsuji ; Poly(lactic acid): Synthesis, Structures, Properties, Processing, and Applications, John Wiley and Sons, USA, **2010**.

[2] Marques D, Gil M, Baptista C, J. Appl. Polym. Sci. **2012**, 125, 283.

[3] Shyamroy S, Garnaik B, Sivaram S, J. Polym. Science., Part A, Polymer Chemistry, **2005**, 43, 2164.