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Polymerization of Epsilon-Caprolactone Using Lipase Enzyme for Medical Applications

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Abstract : Polycaprolactone is polymer belonging to the polyester family that has noticeable characteristics of biodegradability and biocompatibility which is essential for medical applications. Polycaprolactone is produced by the ring opening polymerization of the monomer epsilon-Caprolactone (ε-CL) which is a closed ester, comprising of seven-membered ring. This process is normally catalysed by metallic components such as stannous octoate. It is difficult to remove the catalysts after the reaction, and they are also toxic to the human body. An alternate route of using enzymes as catalysts is being employed to reduce the toxicity. Lipase enzyme is a subclass of esterase that can easily attack the ester bonds of ε-CL. This research paper throws light on the extraction of lipase from germinating sunflower seeds and the activity of the biocatalyst in the polymerization of ε-CL. Germinating Sunflower seeds were crushed with fine sand in phosphate buffer of pH 6.5 into a fine paste which was centrifuged at 5000rpm for 10 minutes. The clear solution of the enzyme was tested for activity at various pH ranging from 5 to 7 and temperature ranging from 40oC to 70oC. The enzyme was active at pH6.0 and at 600C temperature. Polymerization of ε-CL was done using toluene as solvent with the catalysis of lipase enzyme, after which chloroform was added to terminate the reaction and was washed in cold methanol to obtain the polymer. The polymerization was done by varying the time from 72 hours to 6 days and tested for the molecular weight and the conversion of the monomer. The molecular weight obtained at 6 days is comparably higher. This method will be very effective, economical and eco-friendly to produce as the enzyme used can be regenerated as such at the end of the reaction and can be reused. The obtained polymers can be used for drug delivery and other medical applications.

Keywords : lipase, monomer, polycaprolactone, polymerization
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