Ultrasound-Assisted Rapid Extraction of Bacterial Intracellular Medium-Chain-Length Poly(3-Hydroxyalkanoates) (mcl-PHAs) in Medium Mixture of Solvent/Marginal Non-solvent

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Abstract Intracellular medium-chain-length poly(3-hydroxyalkanoates) (PHAs) produced by Pseudomonas putida Bet001 were extracted in an ultrasound-assisted process. A mixture of acetone (solvent) and heptane (marginal non-solvent) was used as the extraction medium. The effects of volumetric energy dissipation, extraction medium ratio and irradiation time on the extraction process were investigated. Sonication frequency of 37 kHz and heptane as marginal non-solvent facilitated the process. Following optimization, high PHA extraction rate of $74 \times 10^{-3}$ g PHA g$^{-1}$ dried biomass min$^{-1}$ was observed at ultrasonic energy output of $1151 \pm 3$ J ml$^{-1}$ with 50:50 solvent/marginal non-solvent ratio for irradiation time of 5 min. PHA showed good stability under the rapid extraction process.

Keywords Downstream processing · Ultrasonication · Organic solvent · Medium-chain-length PHA · Rapid extraction

conditions, e.g. when essential nutrients like nitrogen, oxygen and sulphur become limited [1,2]. They normally comprised of monomers having 6–14 carbon atom chain length [3]. Unlike short-chain-length PHA, mcl-PHA has the potential to be used in the elastic plastic film production [4]. In addition, the polymer has huge potential in niche applications such as scaffold in tissue engineering, smart carriers for drug delivery, inter-positional spacers [5–7].

A number of bacteria were reported to accumulate mcl-PHA. Among them is the fluorescent pseudomonads belonging to rRNA homology group I [8]. Species such as Pseudomonas putida, Pseudomonas aeruginosa and Pseudomonas oleovorans were well known for their mcl-PHA accumulation [9–11]. The ultimate advantage of bacterial PHA production process is that the bacteria are able to grow on various renewable carbon sources that can be incorporated into PHA. Much attentions had been given towards low-cost PHA synthesis by means of genetic engineering and use of cheap and renewable carbon sources [12,13]. For