以甘油為碳源探討放線菌生產ε-聚離胺酸之研究

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摘 要

ε-聚離胺酸(ε-Poly-lysine；ε-PL)是由微生物發酵生產的天然生物性材料。ε-PL具有水溶、可食及生物可分解等特性且其本身或分解之產物對人體及環境不具毒性。由於具極佳的抑菌活性，水溶性強，熱穩定性高，食用安全，添加微量即能奏效，又不影響風味，因此在食品防腐領域得到廣泛應用。本研究以野外篩選之菌株Streptomyces albulus DYU 1為菌株，並以甘油為碳源，用二階段式發酵培養生產ε-PL。Streptomyces albulus DYU 1先進行第一階段培菌後，再將菌體饋入第二階段生產培養基中培養，並以一次一因子探討第二階段生產培養基之最適培養基組成，再以回應曲面法探討生產培養基中之甘油、(NH4)2SO4及pH值對ε-PL產量的影響，並以此最適培養基組成，進行小型發酵槽(10L)之批次發酵培養以生產ε-PL。在一次一因子探討第二階段生產培養基中，碳、氮源對ε-聚離胺酸生產之影響，發現對生產ε-聚離胺酸影響最大的是(NH4)2SO4，其次是甘油，環境因子部分則是pH值具有明顯的影響；最適培養條件為甘油 25 g/L、(NH4)2SO4 10 g/L、檸檬酸 18 g/L和L-lysine 1.6 g/L，在此條件下Streptomyces albulus DYU 1 於30℃、160 rpm培養六天後可生產約 1.2 g/L ~ 1.6 g/L的ε-PL。依據上述一次一因子實驗結果進一步以回應曲面法探討最佳產量，從一階回應曲面實驗設計、陡升路徑實驗設計到二階回應曲面實驗設計(中心混成)，發現在二階回應曲面實驗設計之迴歸方程式無法適切的表達此一模式在實驗數據上之適用性。同時，迴歸運算後之理論值與實際值差異大，表示契合度低，因此將以一階模型所得的最佳設計點組成濃度(甘油濃度25 g/L、(NH4)2SO4濃度10 g/L、pH值4.5)，進行發酵槽培養。在發酵槽批次培養方面，首先將菌體以搖瓶培養方式在pH值6.8條件下，培養36小時後；再將菌體分離後置於上述最佳培養基中，並控制pH值在3.5、4、4.5，培養6天，結果顯示甘油消耗量分別為13.553 g/L、17.379 g/L和19.468 g/L；ε-PL濃度分別為1.17 g/L、2.103 g/L和1.78 g/L，其中以pH值控制在4時為最佳。當pH值控制在4，上述培養基中之甘油濃度小於10 g/L時，即進行饋料甘油至25 g/L，經一次饋料後，ε-PL之最終產量為2.805 g/L，產量增加1.3倍(由2.103 g/L增加至2.805 g/L)。由本研究所得到的結果發現Streptomyces albulus DYU 1可利用甘油生產生物可分解高分子ε-PL，因此將來應用至廢甘油之轉換可提高生質柴油副產物(甘油)之經濟價值，同時解決廢甘油衍生之環保問題。

關鍵詞：ε-聚離胺酸、二階段培養、回應曲面法、發酵槽

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