3 - 81 Enhancement of Bioproduction of Butyrate by Heavy-ion Irradiation

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Butyric acid as a renewable resource has become an increasingly attractive alternative to petroleum based fuels. *Clostridium tyrobutyricum* is well documented as a fermentation strain for the production of acids. However, it has been reported that butyrate inhibits its growth, and the accumulation of acetate also inhibits biomass synthesis, making production of butyric acid from conventional fermentation processes economically challenging. The present study aimed to identify whether irradiation of *C. tyrobutyricum* cells makes them more tolerant to butyric acid inhibition and increases the production of butyrate compared with wild type.

In this work, the fermentation kinetics of *C. tyrobutyricum* cultures after being classically adapted for growth at 3.6, 7.2 and 10.8 g/L equivalents were studied. As shown in Fig. 1, regardless of the irradiation used, there was a gradual inhibition of cell growth at butyric acid concentrations above 10.8 g/L, with no growth observed at butyric acid concentrations above 3.6 g/L for the wild-type strain during the first 54 h of fermentation. The sodium dodecyl sulfate polyacrylamide gel electrophoresis also showed significantly different expression levels of proteins with molecular mass around the wild-type and irradiated strains. The results showed that the proportion of proteins with molecular weights of 85 and 106 kDa was much higher for the irradiated strains. The specific growth rate decreased by 50% (from 0.42 to 0.21 h^{-1}) and the final concentration of butyrate increased by 68% (from 22.7 to 33.4 g/L) for the strain irradiated with 40 Gy of carbon ions of 114 MeV/u compared with the wild-type strains.

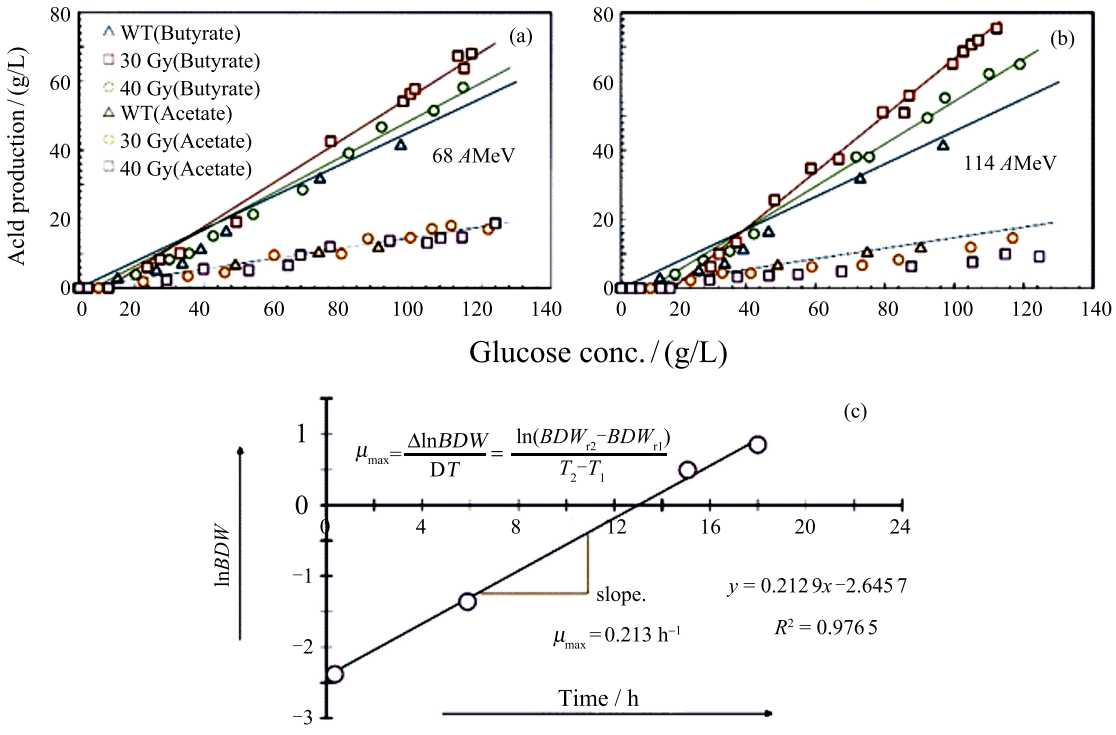

Fig. 1 (color online) Comparison of acid production for the wild-type and irradiated *C. tyrobutyricum* cells.

This study demonstrates that butyric acid production from glucose can be significantly improved and enhanced by using $^{12}C^{6+}$ heavy ion irradiated *C. tyrobutyricum*. Future work includes adaptation of the concept of acetone-butanol-ethanol fermentation for use in a continuous fibrous-bed bioreactor by using $^{12}C^{6+}$ heavy ion irradiated Clostridium sp. to improve and enhance the bioproduction of biofuels. Improvement in the production of biofuels should ultimately make them more competitive in the marketplace.