Immobilization of Clostridium kluyveri on wheat straw to alleviate ammonia inhibition during chain elongation for n-caproate production

Biosynthesis of n-caproate from waste streams rich in acetate and ethanol through chain elongation has offered a potentially sustainable way for future production of liquid biofuels. However, most of the waste streams that fit for the purpose (e.g., digestate) are also rich in ammonium which at high concentration may cause toxic effects on the bioconversion process. This study aims to develop a robust, efficient, and cost-effective chain elongation process with high caproate productivity and tolerance to high ammonia concentration, through immobilization of Clostridium kluyveri on biomass particles as immobilization material. The threshold ammonia concentration for suspended cells cultivation was 2.1g/L, while it was higher than 5.0g/L for the wheat straw immobilized system. The caproate production process was dependent on the selected carriers and was performing in the order of: wheat straw > grass straw > saw dust. The biofilm immobilized on the wheat straw showed good reuse capability for caproate production under high ammonia concentration. Moreover, the lag phase for caproate production was shortened from 72 to 30h after 8 times reuse. These results proved that caproate production and tolerance of chain elongation to ammonia toxicity could be enhanced via cell immobilization. This study offers insight into future development of efficient and cost-effective chain elongation system for production of caproate and other value-added products.

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