[Research Title]

Development of Microbial Cultivation and Crystallization Strategies for the Production of Valuable Materials Using Methane as a Carbon Source.

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[Abstract]

Biomass-derived methane produced by methane fermentation is mainly used as fuel gas. However, when methane is used as fuel, there is little economic benefit for small-scale facilities. Therefore, it is necessary to create new value for biomass-derived methane to promote the dissemination of methane fermentation technology and the utilization of unused biomass for the establishment of a sustainable society.

In this study, we aimed to develop a process for producing valuable substances from methane using the metabolism of microorganisms. The process of producing ectoine, known as a high value-added substance, from methane using the halophilic aerobic methane-oxidizing bacteria was adopted as a role model. Specifically, we focused on the technological development of a synthesis process to produce ectoine by methane-oxidizing bacteria (sub-theme 1) and the operating conditions for obtaining crystalline particles of ectoine with desired characteristics by crystallization in a separation and purification process (sub-theme 2).

In sub-theme 1, the effects of nitrogen source and salinity during the cultivation were determined from growth rate and ectoine production. In addition, we found the culture conditions that maximize the amount of ectoine in the synthesis process. The effect of hydrogen sulfide on the growth rate and the ectoine production was also investigated. Finally, a lab-scale continuous gas-flow bioreactor with a hollow-fiber gas-permeable membrane was constructed and operated to demonstrate of synthesis process.

In sub-theme 2, the effects of operating conditions during the crystallization process, which is known to be a rate-limiting factor for productivity, on the characteristics of ectoine crystalline particles were found. Furthermore, experimental result indicates the important operating conditions for controlling the characteristics of ectoine crystalline particles. In the separation and purification process, the relationship between the operating conditions of the continuous crystallizer and characteristics of crystalline particles was revealed from the viewpoint of improving productivity and reducing environmental impact.

[References]

Amari, S., Ohashi, S., Takiyama, H. (2023). Effect of properties of microcrystals and impurities on the growth rate enhancement of crystalline particles in suspension. *Desalination*, 567, 116987.https://doi.org/10.1016/j.desal.2023.116987

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