Opinion

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The Metabolic Intermediates of Lignin Biodegradation

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Description

Bathyarchaeota, a newly discovered archaeal phylum with approximately 25 subgroups, is widespread in anaerobic environments like marine sediments, soils, and subsurface petroleum reservoirs. Although recent studies demonstrated that Bathyarchaeota can obtain enrichment by utilizing lignin as an energy source, there is a lack of pure culture, so our knowledge of Bathyarchaeota is still based on genomic data. Bathyarchaeota enrichment cultures from mangrove sediments were successfully established in the laboratory using lignin and three aldehyde compounds, namely syringaldehyde, 4-hydroxybenzaldehyde, and vanillin, which were recognized as the metabolic intermediates of lignin biodegradation. The changes in gene copy numbers, microbial composition, and substrate consumption suggested that Bathyarchaeota's growth in the enrichment culture was significantly sped up by syringaldehyde. In contrast, Bathyarchaeota had a relative abundance that was as high as 97.13 percent in terms of the archaeal composition. In particular, bathyarchaeotal genome subgroup 6 accounted for more than 99.9 percent of Bathyarchaeota. 4.74 mmol L-1 methane was also found in the enrichment culture that had been modified with syringaldehyde as a substrate after approximately 117 days of incuba the design of high-efficiency enrichment cultures and knowledge of Bathyarchaeota's metabolic and ecological roles in nature will be made easier by this work.

Investigate the Internal Mechanism of Low-Temperature Anaerobic Digestion

Based on the operating temperature, Anaerobic Digestion technology can be divided into low-temperature AD (20°C), mesophilic AD and thermophilic AD (55–60°C). More than 50% of the world's regions have an annual average temperature below 8°C and more than 60% of the world's regions have an annual average temperature below 20°C. In order to generate heat, the use of mesophilic and thermophilic AD in these areas must require more energy from the outside. The ability of low-temperature AD to reduce additional energy consumption makes it very appealing for AD to be promoted and used in cold regions. However, low-temperature AD is constrained by numerous factors. For instance, the activity of microorganisms will decrease at low temperatures, and changes in the digestate's physical and chemical parameters will further inhibit the life activities of microorganisms like methanogens. Microbiological enhancement, reactor optimization, substrate pretreatment, additives, and process optimization are all methods that have been used by researchers to enhance the efficiency of low-temperature AD. Numerous studies have been carried out to investigate the internal mechanism of low-temperature AD. Microorganisms' normal metabolism at low temperatures is necessary for low-temperature AD. Over the course of their long-term evolution, psychophilic microorganisms have developed a number of distinct cold-adaptive mechanisms, such as the maintenance of cell membrane fluidity, the functional expression of cold shock proteins and regulation at the molecular and gene levels. As a result, the enrichment culture of psychrophilic microorganisms can boost low-temperature AD efficiency. Zheng and co 2020 examined the bacterial group LTF-27, which is capable of efficiently breaking down straw at 15°C. At low temperatures, the degradation rates of cellulose, hemicellulose, and lignin reached 71.7 percent, 65.6 percent, and 12.5 percent, respectively. Ahmed and others 2019) experimented three times with wheat straw as the substrate for low-temperature domestication. Specific methane production increased by 27.9%compared to before domestication, according to the findings.

Electrons Generated by Anode Micro-organisms

Electron acceptors and donors in Microbial Electrochemical Systems (MES) are microorganisms attached to the cathode and anode. The electrons generated by the anode microorganisms are transferred to the anode by oxidizing organic matter. The electrons are then transferred to the cathode microorganisms through an external circuit triggered by an external voltage. Even though the study of MES in low-temperature AD is still in the experimental stage, it has been recognized to improve low-temperature AD performance. used anaerobic sludge as an inoculum and supplemented MES at 10°C to improve low-temperature AD. When the cathodic potential was 0.90 V, the results showed that the methane production rate of the supplemented MES group was 5.3–6.6 times higher than that of the control group constructed a MES AD reactor with a rotating impeller electrode and used kitchen waste inoculated with sludge as a substrate for low-temperature AD at 20°C. It was discovered that the rate of methane production was 133% higher than that of the control group. Tian and co. 2019 utilized novel materials: for low-temperature AD at 12 °C, graphene/polypyridine and manganese dioxide nanoparticles/polypyridine as electrodes for MES. The rate of methane production was increased by 22.8 percent and 39.0 percent, respectively, by the two groups of novel electrodes. PHA production with a mix of carbon wastes and mixed culture has been shown to be less expensive than the more expensive pure culture method. Continuous research has been carried out with the intention of improving the performance of mixed culture in PHA production and simplifying the production scheme to further reduce production costs. In order to produce a culture that is enriched with PHA accumulators and capable of stable PHA production, the selection of the carbon feedstock and enrichment strategies must primarily be taken into consideration. The feast-and-famine method with periodic carbon supplies for culture enrichment was used in the majority of mixed culture process studies. According to the findings, the enriched culture performed similarly to the pure culture in terms of yield and PHA content 30–80%. However, improvising enrichment strategies could overcome the low productivity that prevents mixed culture from producing PHA at an industrial scale. This survey zooms into the assessment of two stage and three stage processes in PHA creation by using various feed stocks. The appropriate feedstock, enrichment conditions, stability of the enriched culture, and nutrient supplementation are highlighted as crucial parameters for PHA production. Uncoupled C and N supply and extended cultivation are presented as potential enrichment strategies for overcoming low productivity. Future research is warranted into the effects of various enrichment strategies on the microbial community, produced PHA characteristics, and PHA production performance.