Focus on Microbiology in Biogas Research

Role of Lactic Acid in the Biogas Process

In their latest joint project PFI Biotechnology and the Microbiology Institute of Mainz University have been studying the complex microbial degradation pathways of organic materials in biogas fermenters. The researchers working in the collaborative research project supported by the German Specialist Agency for Renewable Resources (Fachagentur Nachwachsende Rohstoffe, FNR) were particularly interested in lactic acid as an intermediate; this degradation product of sugars and plant polymers is produced by numerous microorganisms. It is of significance at various interfaces of the biogas process. For example, it is the most important organic acid in ensiled feed substrates. Moreover, earlier projects already indicated that this intermediate plays a key role in the degradation of starch.

A major goal of the project was to isolate bacteria from working plants and to analyse which ones are involved in the synthesis and degradation of lactic acid. A further aim was to determine whether the use of feed substrates with particularly high starch content had any influence on the composition of the microbial population in the biogas fermenters.

In the context of the project, the university researchers concentrated above all on microoganisms able to form lactic acid. In contrast, PFI focused attention on the degradation of lactic acid in biogas fermenters. In addition to the microbiological analyses, regular investigations were performed on five biogas plants in the federal states of Rhineland-Palatinate and Saarland. Both the fermenters of the biogas plants and the feed substrates used were subjected to extensive chemical analyses. This was done to determine whether there were any connections between the feed substrate used, the stability of the fermentation process, and the presence of certain microorganisms in the biogas fermenter.

In the course of the project, the researchers were able to obtain many new isolates from the biogas plants examined. More than 250 bacterial species were isolated and characterised physiologically and phylogenetically. Thus important new insights could be gained for basic research; particularly about which bacteria are active in biogas plants and what metabolic functions they perform in the complex system. Interrelationships discovered by the researchers between the proportion of maize and other starch-containing substrates in the feed of the various biogas plants and the presence of certain bacteria were also of particular practical relevance.

Figure 1: Maize and coarse grain, substrates with a high starch content

Thus particularly high cell counts of certain lactic acid-degrading bacteria could be found in biogas plants using mainly substrates of high starch content such as maize and grain. This finding lends support to the researchers' theory that starch is degraded mainly via lactic acid as intermediate in biogas fermenters.

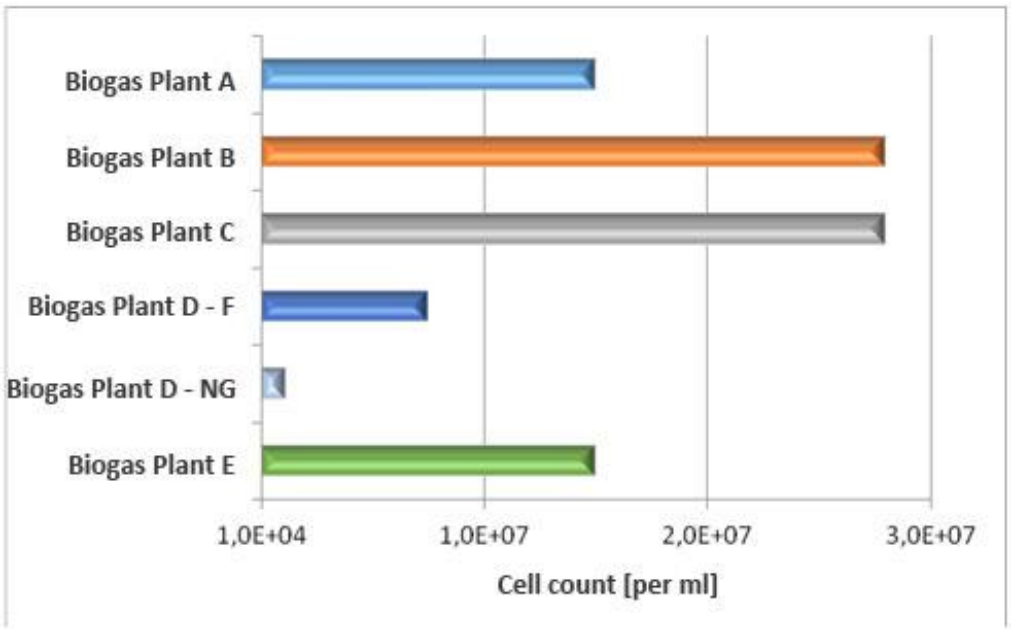

Figure 2: Cell counts of lactic acid-degrading microorganisms in biogas plants with various feed mixes; plants B and C with a high starch content

It could also be established that the microorganisms found degrade lactic acid mainly to acetic acid and propionic acid. These two volatile organic acids occur in cases of overloading of biogas plants and in practice serve as leading indicators of process stability in such plants. These findings, together with the new substrate analysis methods developed in the course of the project, have already found their way into the extensive consultancy and service program offered by PFI Biotechnology for biogas plant operators.

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FNR Fachagentur Nachwachsende Rohstoffe e.V.

Gefördert durch: Bundesministerium für Ernährung und Landwirtschaft aufgrund eines Beschlusses des Deutschen Bundestages

The joint project of the Test and Research Institute Pirmasens and Johannes Gutenberg University of Mainz was funded by the German Federal Ministry of Food and Agriculture (BMEL) through the Specialist Agency for Renewable Resources (FNR) as project coordinator for the Renewable Resources Funding Programme of BMEL in accordance with a resolution adopted by the German Parliament.

We also wish to express our sincere thanks to the operators of the agricultural biogas plants for their active support of this research project.

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