



Production and extraction of C3 and C4 aliphatic carboxylic acids from the anaerobic digestion of waste blood as a model substrate

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This proof-of-concept project focuses on diversification of anaerobic digestion (AD) into the field of industrial biotechnology through the production and harvesting of butyric and propionic acids as intermediate bulk chemicals. These products have value and existing large-scale markets in their own right, and can also be considered for further bio-transformation and as the basis for an extended biorefinery concept. The research is based on the use of animal blood produced in abattoirs, a negative-value waste material, as a fermentation substrate since its high nitrogen content provides buffering to allow the accumulation of acid products at high concentrations without detriment to the acidogenic population due to low pH.

Part of the research will focus on proving the concept that stable high rates of acid production can be achieved and that reactor operating parameters can be used to manipulate systems biology to produce a high quality output under non-sterile conditions. This builds on and will further contribute to recent advances in understanding metabolic pathways and syntrophy in anaerobic digesters that can lead to acid accumulation, and the mechanisms that control this.

The second part of the work focuses on selection and preliminary testing of potential extraction methods that could be applied at large scales, ranging from conventional solvent extraction to more advanced membrane-based systems that could be used in situ in continuous processes. The research will make a preliminary assessment of issues relating to design, cost and resource requirements and environmental impacts of this novel biotechnology.

OBJECTIVES

The overall aim of this research is to prove the concept that, by selection of reactor conditions and substrate type, anaerobic fermentation can be directed towards specified target products in concentrations suitable for extraction and further refining as intermediate bulk chemicals. The specific objectives of the work are:

- To determine whether a total volatile fatty acid (VFA) concentration of 10% is achievable when using blood, a widely available waste product of negative value, as the model substrate

- To make a preliminary assessment of the factors that influence the accumulation of butyric and propionic acids over other VFA species in semi-continuous digestion studies
- To test potential measures to limit CH₄ formation so as to further boost acid product yields
- To develop a process methodology for the recovery of the acid products from the complex fermentation mixture

Funding agency



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