# VALORIZATION OF GAS FERMENTATION ACETATE-RICH OUTFLOW INTO VALUABLE MICROALGAL BIOMASS

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## STATE OF ART

Microalgae can be exploited as source of proteins and lipids for sustainable feed and food. Microalgal photoautotrophic cultivation present limits related to the high operative and investment costs required to maintain adequate light supply rate (reactors with high S/V ratio) to ensure satisfactory productivity [1]. Heterotrophy represents a promising solution: some microalgal strains can grow without light, metabolizing organic compounds as carbon and energy source [1,2]. Moreover, the integration of heterotrophic microalgal production with wastewater or effluents treatment can increase the economic and environmental sustainability of the microalgal biomass production, eliminating the cost of carbon feedstock required in heterotrophy [3].

Through gas fermentation, some acetogens bacteria convert $CO_2$ and $H_2$ into acetic acid, using the Wood–Ljungdahl pathway [4]. However, acetic acid produced through this way presents a low economic value. Using acetate as substrate to produce compounds with higher economic value could be an efficient solution [5].

## PROCESS OVERVIEW AND METHODS

We propose here an innovative approach to overcome both the limitations associated with photoautotrophic growth of microalgae and the economic sustainability of microbial acetate production by gas fermentation. This approach is based on a two-stage fermentation process: the first step consists in the conversion of $CO_2H_2$-based feedstock into acetate through gas fermentation, using the acetogenic strain *Thermoanaerobacter kivui* in a stirred tank reactor (STR); the second step consists in **direct valorization of acetate** as carbon source for the heterotrophic growth of axenic ***Chlorella sorokiniana SAG 211-8k***, leading to **acetate conversion** into valuable biomass (**proteins, lipids**, starch, pigment etc.). In particular, the second step of the process will be discussed in this

*Chlorella* growth was assessed starting from different acetate concentration - 1.1 g $L^{-1}$, 2.2 g $L^{-1}$, 3.3 g $L^{-1}$ - in the medium, obtained by diluting and sterilizing by microfiltration the fermentation effluent of *T. kivui.* During the microalgal growth, samples at different hours were collected to evaluate the biomass production (turbidimetric analysis – 750 nm) and the acetate removal (HPLC analysis); growth kinetics, yields and productivities were evaluated and compared to negative photoautotrophic control. Lipids accumulated by microalgal biomass were extracted using the Bligh and Dyer's extraction; consequently, the fatty acids profile was obtained through GC-MS analysis. The microalgal biomass proteins percentage was acquired using the CHNS elemental analyser. Essential amino acids profiles will be analysed using HPLC.

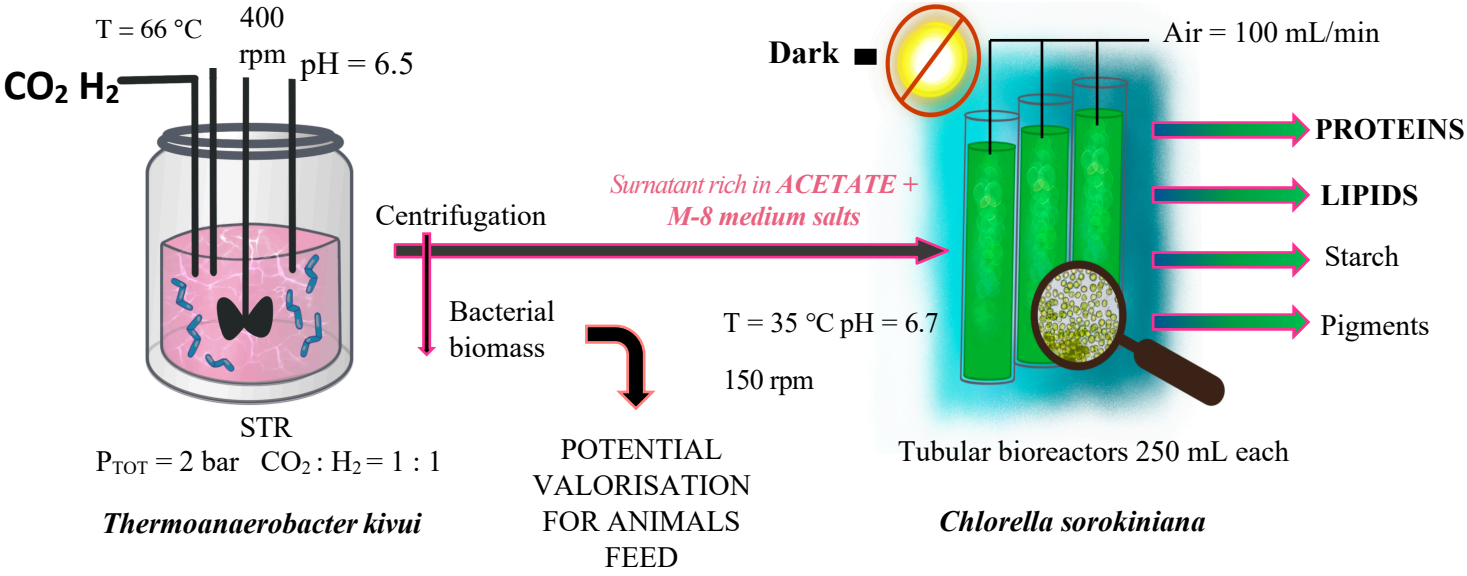
## PRELIMINARY RESULTS AND CONCLUSIONS

*Chlorella sorokiniana* was able to grow on gas fermentation acetate-rich outlow, converting all the acetate present into new biomass; kinetics, yields and productivities were evaluated, obtaining 0.114 ± 0.008 $day^{-1}$ as specific growth rate and 0.607 ± 0.029 g $L^{-1}$ $day^{-1}$ as biomass productivity, respectively. The heterotrophic productivity was 3 times higher compared to the photoautophic one.

25% of lipid in microalgal biomass was calculated after their extraction. GC-MS analysis revealed good percentage of unsaturated fatty acids, including good percentage of linoleic acid and linolenic acid ω-3. Comparing this profile with the fatty acid profile of photoautotrophic condition, no significative differences were highlighted.

Through CHNS analyser, we calculated 53 ± 2 % of proteins. As next goals, essential amino acids profiles will be analysed and comparing with photoautotrophic one (and FAO ideal profile for human consumption) to verify the proteins quality and its potential as sustainable feed and food source. Moreover, higher concentrations of acetate will be evaluated to minimize the dilution step of the process.

## PROCESS OVERVIEW

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