

Hyperthermophilic fermentation of Food Waste allows the reliable recovery of Volatile Fatty Acids (VFA) by means of stripping.

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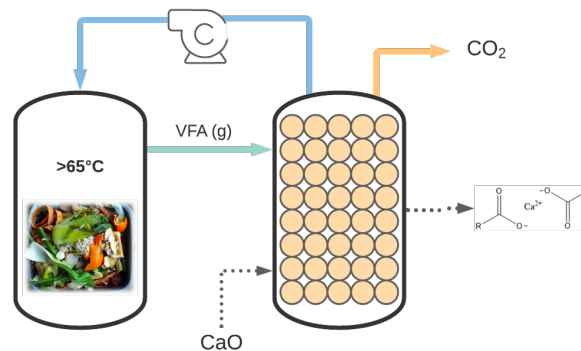
VFAs are important building block chemicals and food/feed additive, with a greatly increasing market demand. Such class of compounds can be produced through acidogenic fermentation from a wide range of waste feedstock with low cost microbial mixed consortia. (Atasoy et al., 2018)

Given the toxicity of VFAs, acidogenic fermentation suffers to product-inhibition. Acidogenic consortia are inhibited with more than 3 g/L VFA with total inhibition at concentration in the 30-50 g/L range (Wang et al., 2014). Such phenomena reduce yields and productivities of acidogenic fermentation. These limitations actually impact process economics and viability of waste conversion to VFA. In situ extraction of products allows to remove the VFA during fermentation, avoiding the exposure to inhibitory product, improving rates and yields of VFA (Teke et al., 2021).

It is possible to use stripping as a simple way to transfer VFAs from a fermentation broth into an alkaline trap, thus obtaining clean VFA salts (Li et al., 2015). Nonetheless, given the low Henry constant of VFAs, the energy consumption for moving large amount of air between fermenter and trap is unacceptable with common mesophilic (37°C) fermentation. Since gas/liquid partition is higher at low pH (<5.5), with long chain fatty acids and at high temperature. Test on model systems showed that increasing temperature from 37°C to 65°C drastically increase the volatilization rate of VFA, unlocking the possibility of the use of stripping for reliable recovery of clean VFA from Waste.

For this reason, a model hyperthermophilic fermenter was coupled with a system for stripping and VFA recovery. Fermentation of food waste at 65°C and VFA product recovery was studied. Fermentation-Stripping allowed to obtain 45% yield (on COD basis) of clean VFA salts. Continuous VFA stripping influences the amount and type of VFA produced, with butyric acid as main fermentation product. Preliminary calculation about energy consumption in the VFA recovery procedure suggests that energy consumption of the hyperthermophilic process can be acceptable for the purpose of VFA production (less than 2 kWh per kg of VFA) and can be significantly reduced with adequate design of fermenter and VFA-trap geometries.

Figure 1: hyperthermophilic fermenter with VFA recovery device



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