CO2 AS CARBON SOURCE FOR MICROBIAL PRODUCTION OF BIOBASED CHEMICALS

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Key Words: CO_2, acetogens, microalgae, bioreactor, photobioreactor

Reducing waste and emissions of greenhouse gases like CO_2 is a major demand for industry. In this context great interest has emerged in biological CO_2-fixing processes which are supposed to be very effective in reducing CO_2 emissions.

Acetogenic bacteria are able to use hydrogen gas for the reduction CO_2. The reductive acetyl-CoA pathway enables the autotrophic production of biobased chemicals like acetate, ethanol, butyrate, butanol, 2,3-butanediol, hexanoate and hexanol. Metabolic engineering of acetogens is a promising approach to enlarge the natural product portfolio. Low product yields and selectivities as well as low biomass densities and inefficient utilization of gaseous substrates are some of the challenges that slow down commercialization so far. The reaction engineering analyses of acetogens and the application of bioreactor designs providing high gas-liquid mass transfer efficiencies will enable new gas fermentation processes overcoming the challenges for further commercialization in the near future.

Microalgae consuming the greenhouse gas CO_2 and using sunlight as energy source could become an important renewable source for biobased chemicals. Since the production cost of most microalgae products from current mass cultivation systems is still prohibitively high, further development is required. To advance economic microalgae mass production new open thin-layer cascade photobioreactors were designed recently up to a pilot scale (50 m^2) for high-cell density cultivation of saline microalgae achieving up to 50 g L^{-1} dry cell mass, which was shown applying physically simulated climate conditions of a Mediterranean summer in Spain in the TUM-AlgaeTec-Center near by Munich, Germany.

Finally, state-of-the-art of phototrophic CO_2-fixation by microalgae and of autotrophic CO_2-fixation by acetogens will be compared with respect to kinetics, process engineering aspects and productivities.

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