

## DISSERTATION SUMMARIES

### Biogas production from chicken manure

Tamás Böjti

Department of Biotechnology, University of Szeged, Szeged, Hungary

Biomass based technologies have several benefits: the necessary substrates are available in large quantities, the generated energy carriers are environmentally friendly, easy to carry and store. Biogas is a renewable energy carrier which is similar to natural gas and can be used in practically all applications to replace natural gas. It is produced by anaerobic fermentation of the organic materials. The problem of poultry waste management has been an increasing concern in many parts of the world due to the huge amount of this waste stream. Pollutants from improperly managed poultry waste can cause serious environmental problems in terms of water, air, and health quality.

Chicken manure (CM) contains two main forms of nitrogen: uric acid and undigested proteins, which represent 70% and 30% of the total nitrogen in CM, respectively. Anaerobic decomposition of uric acid and undigested proteins in CM results in high amounts of unionized ammonia and ammonium ions. Excess ammonia inhibits the anaerobic microbial community and thus methane production. Because of the regular antibiotic treatment in the large-scale chicken plants, first we compared two types of CM containing straw bedding: samples were taken from broiler chickens receiving antibiotic treatment and from untreated chickens. The wide-spectrum antibiotics employed at the chicken farms negatively affected the biogas producing microbial community leading to rapid process failure. The antibiotic-free substrate was more suitable for microbial decomposition. Increasing the organic loading in the batch reactors led to elevated biomethane yields. Without antibiotics the system was more stable and it produced significant amounts of biogas for a longer period. The antibiotic-free substrate was used in the subsequent experiments.

The possibility of washing CM with water was tested next with the aim of decreasing the inhibitory nitrogen content of the substrate. After two days soaking CM in tap water, the liquid and solid phases were separated and significant nitrogen content was detected in the water phase. Removal of excess nitrogen-containing compounds improved the suitability of CM as sole substrate for anaerobic digestion. Biogas fermentation experiments were carried out with washed CM at mesophilic temperature (37 °C) in batch and continuous operational modes. The results demonstrated that anaerobic fermentation became sustainable when the reactors were fed with washed CM, which confirmed that ammonium concentration was indeed the limiting parameter in the anaerobic digestion of CM.

The simple and inexpensive method of removing nitrogen-rich water soluble components from CM, however, resulted in a large volume of water with high nitrogen and other dissolved organics content as a residual waste. In order to improve the economic value of the process, the separated liquid phase (CM-water) was used as a nutrient solution for algae because algae need a significant amount of nitrogen source for growth. A *Chlorella sp.* strain was cultivated in these experiments. The extreme dark color of the CM-water fraction did not permit its direct use for algae cultivation. In order to avoid light limitation CM-water was further diluted with water. At the optimal dilution ratio (CM-water : distilled water) the *Chlorella* culture grew vigorously and reached higher optical density than in its default growth medium. The harvested algal biomass could be recycled into the biogas generating process.

CM has low C/N ratio which is not favorable for evolving biogas with high methane content. To solve this problem we developed a co-fermentation scheme using the solid fraction of washed CM and corn stover, to increase this ratio. These experiments yielded promising results.

Supervisor: Kornél L. Kovács  
E-mail: [tamas.bojti@gmail.com](mailto:tamas.bojti@gmail.com)

### Genes of the LATERAL ORGAN BOUNDARIES domain transcription factor family in *Brachypodium distachyon*

Magdolna Gombos

Laboratory of Plant Architecture and Development, Institute of Plant Biology, Biological Research Center of the Hungarian Academy of Sciences, Szeged, Hungary

The fascinating morphological plasticity of higher plants and formation of efficient shoot and root architecture for adaptation to continuously changing environment is ensured by their ability to establish new organs during their entire lifespan. This unique feature of plants is maintained by the reactivation of cell cycle in certain cells of differentiated tissues and by dynamic regulation of meristematic cell activity as well (Birnbaum et al. 2008; Bhojwani et al. 2013).

The precise coordination of division and differentiation of indetermined cells is essential in respect of proper and proportional organogenesis. Researches on plant development showed that special cells at boundaries between parental meristems and developing primordia play a dual role in this process by separating and maintaining meristem and organ domains. In accordance with their special function these cells express unique set of genes that reduce cell division and auxin efflux carrier activity but activate meristematic gene expression at the same time (Rast et al. 2008).