Efforts in the valorization of food waste to obtain commodities, materials and added-value chemicals

Jorge Blanco[1,2], Sergi Abad[2], Joachim Venus[1], Xavier Turon[2]

[1] *Leibniz-Institute for Agricultural Engineering Potsdam-Bornim, Potsdam, Germany*
[2] *Bioengineering Department, IQS, Ramon Llull University, Barcelona – xavier.turon@iqs.edu*

Keywords: food waste, lactic acid, poly unsaturated fatty acids - PUFA.

Many efforts are directed nowadays to bioconversion/fermentation processes using crops, green plant materials and lignocellulosics including residues/by-products (bagasse, oilseed cake/meal, molasses, whey, coffee residues, waste bread) as raw materials. Bioconversion aims the production of value added goods by biological or a combination of biological and chemical conversion processes. Production of bio-based chemicals using renewable sources to minimize the dependence on petroleum based chemicals has attracted considerable interest.

In this contribution food waste residues are the target of the joint research in the context of the EUBIs COST action. Tests on substrate preparation, microbial transformation, physiochemical basic research on substance separation as well as the technological optimization of fermentation and down-stream processing steps are being carried out.

Enzymatic saccharification of waste-bread to fermentable sugars was developed to feed a batch and continuous processes to produce lactic acid (LA). Enzymatic hydrolysis based upon new enzymes and process parameters (dosage, temperature, pH-value, duration) were assayed. The influence of the different pre-treatment steps on the subsequent fermentation and down-streaming processing was found to be crucial. Impurities remaining after the down-stream purification affect the capacity and quality of the poly-lactic acid, which is the typical material produced out of LA. Best pretreatment conditions and enzymes screened, together with optimal fermentation process parameters were selected to perform a scale-up study at the ATB pilot plant in Potsdam, Germany. Volumes of 50 and 600L were used in fermentations runs. Enantioselective manufacture of pure L- and/or D-Lactic Acid (ee >99% for both) could be achieved in a high-performance bioprocess.

A different fermentation process was designed to obtain long chain poly unsaturated fatty acids (LC-PUFA). Omega-3 LC-PUFA have been determined to be essential in human as well as other animals diet. They are essential and give innumerable advantages as cardiovascular, atherosclerosis and cancer diseases prevention; infant brain and vision development or diabetes[1-5]. Fermentation uses raw crude glycerol from the biodiesel industry as carbon source. But similar results can be achieved when using defined media with glucose or pure glycerol (unpublished results). Recent efforts are focused on the utilization of molasses, byproduct from the sugar from the sugar industry, as carbon source.

Other added-value metabolites obtained with this fermentation process are complex lipids as squalene, or antioxidant pigments as astaxhantin or b-carotenes[6]. Different strains and processes conditions are required according to the desired final product.

Acknowledgements

JB and JV acknowledge the funding from BREAD4PLA project from the European Commission Programme LIFE+, Sub-programme: Environment Policy and Governance. SA acknowledges INTERQUIM SA for the PhD scholarship provided.

References

1. Connor WE. Am J Clin Nutr. 2000; 71(1 Suppl):171S-5S.
2. Thies F, Garry JM, Yaqoob P, et al. Lancet 2003; 361: 477-85.
3. Kris-Etherton PM, Harris WS, Appel LJ. Arterioscler Thromb 2003a; 23(2):e20-30.
4. Hering J., Garrean S., Dekoj T., et al. Surg Oncol 2007; 14(12):3620-3628.
5. Abad S, Turon X.. Biotech Adv. 2012, 30 (3):733-741.
6. Turon X, Abad S. EU BC&E 2013 Conference, 21st European Biomass Conference Proceedings.