Integrated approaches in dealing with dilute heterogeneous biomass sources for the production of chemicals

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With the need for the replacement of fossil based resources for chemicals, materials and fuels, biorefinery as well as new synthetic routes and catalysts are being developed. Often these technologies are developed independently of each other and can give rise to a (possibly prohibitive) large number of steps. Allied to this is the challenge to isolate specific molecules for transformation from dilute heterogeneous biomass sources. Here we describe how certain transformations can lead to both product formation and aid isolation from complex dilute media.

Bacterial polyhydroxyalkanoates (PHA) can be obtained from volatile fatty acids present in complex and dilute agro-food waste streams. Thus allowing the formation of an insoluble more defined compound. PHA has been investigated as a biopolymer but application is hampered by a number of issues including its processing. However, it is also and an attractive intermediate towards chemicals. The PHA polyhydroxybutyrate (PHB) can be converted to methyl crotonate (MC), which can be converted *via* cross metathesis with ethylene to methyl acrylate and propylene, two industrially important monomers. The reaction mechanism of this conversion as a function of reaction conditions will be discussed.

However, isolation of PHA is complex and costly. To circumvent this, whole cells containing PHA may be used in the conversion of the 3-hydroxybutyrate monomer to MC. Due to increased complexity of the reaction mixture, the effect of the presence of other small molecules, magnesium salts and water will be discussed to evaluate the need for downstream processing. Overall, it is possible to bypass a major part of the downstream processing of PHA for the production of biobased chemicals.

Amino acids also present opportunities to produce N containing chemicals. In a similar approach to above, complex mixtures of amino acids (from rest streams) can be converted to cyanophycin (co-polymer of aspartic acid and arginine) and used synthetically. Alternatively the mixtures can undergo specific reactions which evokes a change in chemical or physical nature allowing product synthesis and isolation simultaneously.