Modelling of enzymatic hydrolysis of carbohydrates

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Objective

The aim of this research is to develop kinetic models for a number of enzymatic conversions relevant for industrial processes, by combining data on subsite maps and binding energies with knowledge on substrate structures.

Approach

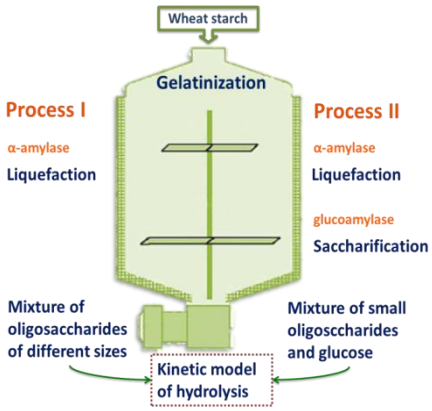

Figure 1. Approach used for collecting data for kinetic modelling of starch hydrolysis

Starch hydrolysis is conducted in two setups as shown in Figure 1 using different substrate concentrations (up to 60%). Products obtained during those hydrolysis reactions are analysed using HPSEC - high pressure size exclusion chromatography and weight fractions of saccharides composed of up to 300 glucose units are calculated (Figure 3). Experimental data create the fundaments for the kinetic models describing those reactions.

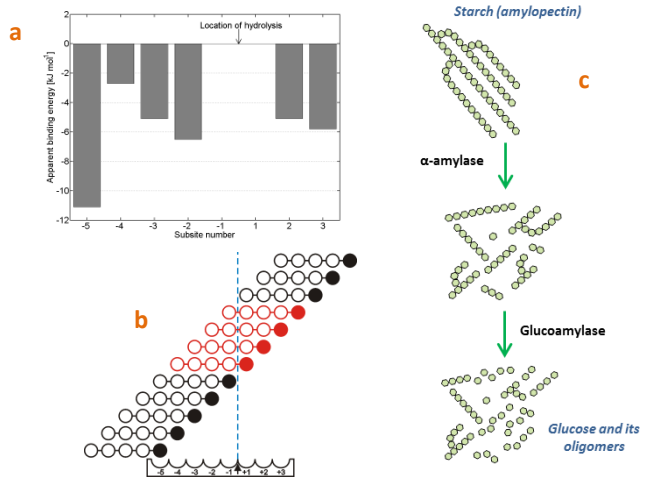

Figure 2. a. Binding energies of catalytic subsites of α-amylase from *B. licheniformis*[1]. **b**. Possible ways of binding between substrate and the enzyme. Red coloured substrates form a productive complex[2]. **c**. Schematic representation of the catalytic action of α-amylase and glucoamylase.

Results

Preliminary results are depicted in figure 3 and are an example of process I. The figure shows changes in content of oligomers of glucose during the course of reaction. Similar type of data are obtained for this reaction taking place at lower temperature (50°C) and also with higher initial substrate concentrations.

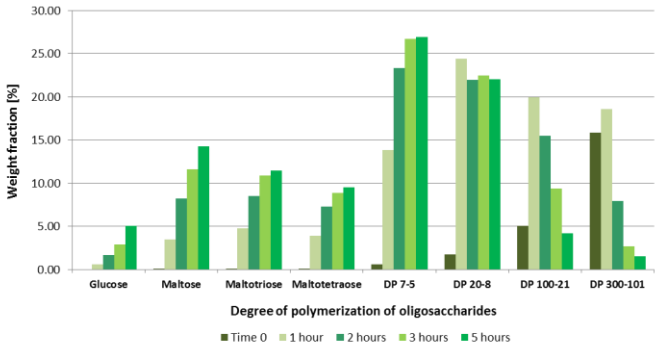

Figure 3. Contents of oligosaccharides during hydrolysis of 10%w/w wheat starch solution with α-amylase from *B. licheniformis* at 80°C.

References

1) Kandra L., Remenyik J., Gyemant G., Liptak A. 2006. Effect of temperature on subsite map of *Bacillus licheniformis* α-amylase. Acta Biologica Hungarica, 57 (3), pp. 367-375
2) Besselink T., Baks T., Janssen A.E.M., Boom R.M. 2008. A stochastic model for predicting dextrose equivalent and saccharide composition during hydrolysis of starch by α-amylase. Biotechnology and Bioengineering, 100 (4), pp. 684-697

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