Isomalto/Malto-polysaccharide: a novel polysaccharide from starch

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Introduction

- Starch consists of α-1,4 and α-1,6 linked glucose units.

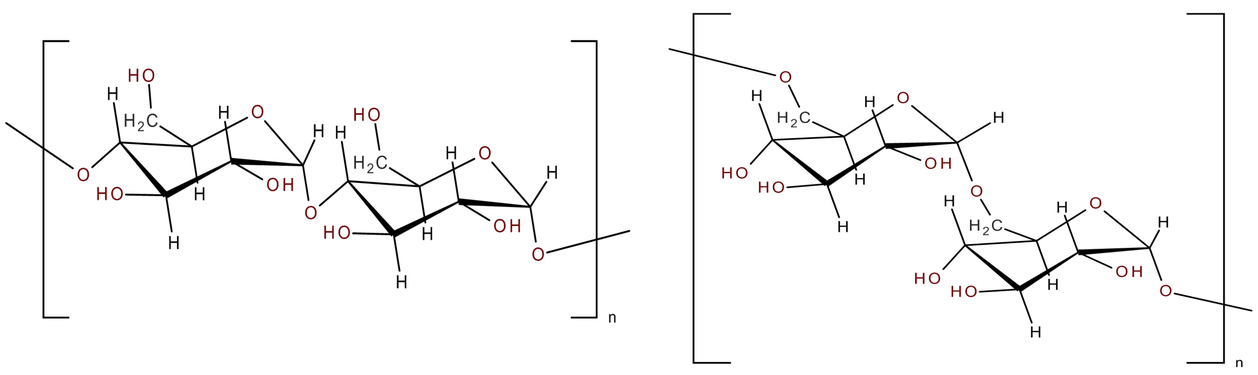

Figure 1. Molecular structure of an α-1,4 linked glucose backbone (left) and an α-1,6 linked glucose backbone (right).

- 4,6-α-Glucanotransferase (GtfB-ΔN) is an enzyme that cleaves the α-1,4 glycosidic linkages and introduces α-1,6 glycosidic linkages.

- This change in the molecular building blocks of starch results in the formation of Isomalto/Malto-Polysaccharides (IMMPs); a group of α-glucans with a new combination of physico-chemical properties.

Objective

"The synthesis and characterization of Isomalto/Malto-Polysaccharides derived from starch."

Current Research

Starches from a variety of botanical sources were converted to their respective IMMP using the GtfB-ΔN enzyme.

❖Chemical characterization:

- IMMPs were fractionated on preparative scale with a SEC-RI setup on a 4.3L column ➔

- Obtained IMMPs and their respective fractions are investigated with:
  - ^{1}H NMR and methylation analysis for linkage types.
  - GPC-MALLS (in DMSO) and dynamic light scattering (in H_2O) for the determination of molecular weight and its distribution.

❖Rheological properties and glass transition temperatures of IMMPs are investigated at this moment.

❖Enzymatic fingerprinting is also used to unravel IMMP structure.

Results

- (waxy-) Potato, (waxy-) Maize, (waxy-) Rice and Sweet Potato starch were converted to their respective IMMPs. Potato Starch is taken as an example in this section:

- Potato starch, containing ~3.7% α-1,6, was converted to its respective Potato IMMP containing 26.6% α-1,6.

Preparative fractionation of the produced Potato IMMP performed in milliQ:

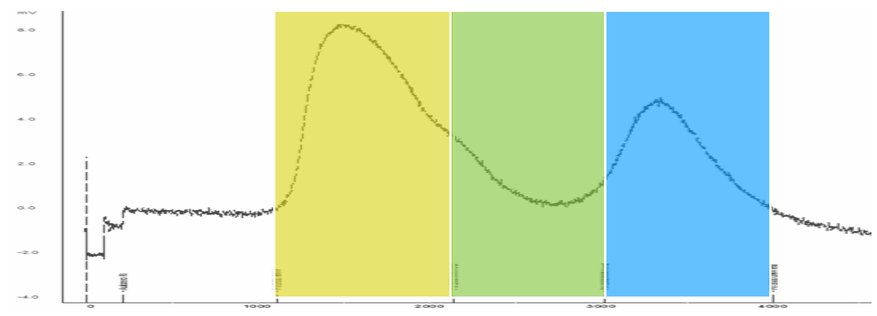

Figure 2. Chromatogram of Potato IMMP fractionation on an Akta Explorer with a 4,3L Sephacryl column running on milliQ. Fractions were collected, concentrated in a rotary evaporator and subsequently freeze-dried.

The isolated fractions were labelled: high, medium and low in M_W and injected on a GPC-MALLS system:

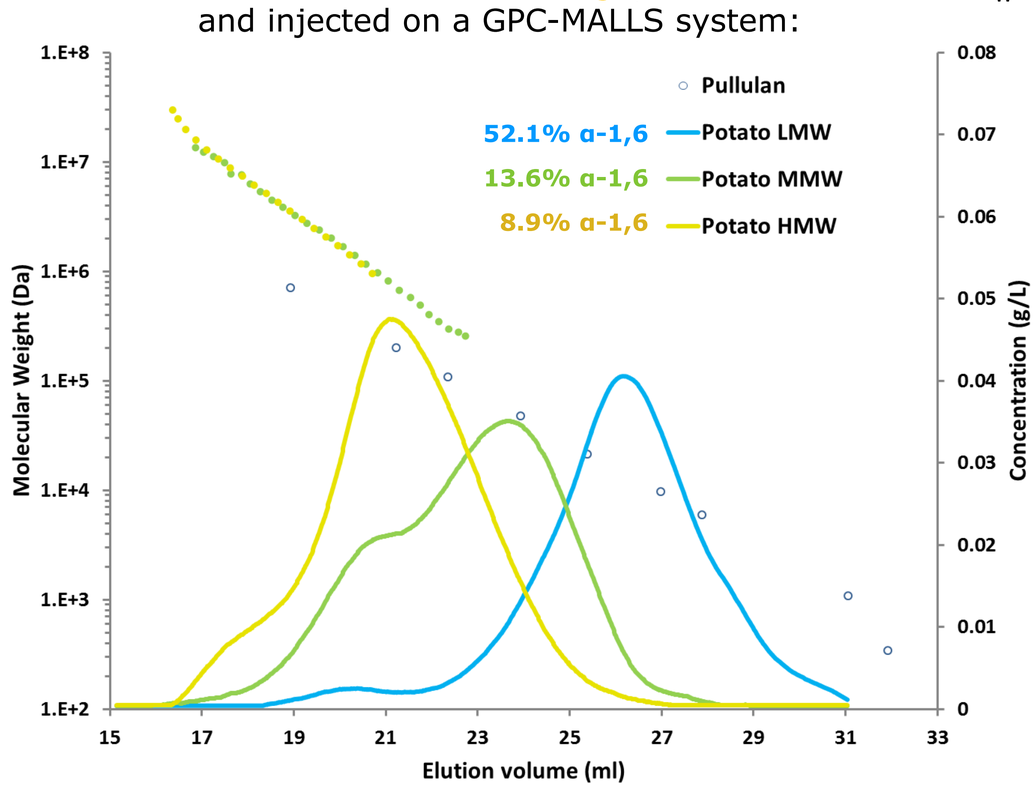

Figure 3. Combined chromatograms of the obtained Potato IMMP fractions injected on a GPC column running on DMSO+0.5%(w/v) LiBr. Molecular weight (Da) is plotted in the left vertical axis, concentration (g/L) is plotted on the right vertical axis. Pullulan standards are indicated with the white dots: °.

Conclusions

- Isomalto/Malto-Polysaccharides were successfully produced from a wide variety of starches.

- The high molecular weight fraction of an IMMP contains significantly less α-1,6 linkages compared to the corresponding low molecular weight fraction.

- Previous research indicated that amylose would be fully converted, however it appears that this amylose fraction (prevalent in the low molecular weight) is only partly converted. Up to 54.5% α-1,6 depending on the starch type.

Acknowledgements

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