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Publication date:
2012

Document version
Peer reviewed version

Citation for published version (APA):
Large-scale extraction and molecular analysis of cereal β-glucans

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Aim
To conduct thorough comparison of barley and oat β-glucan structure and functionality all the way from raw plant material to health effects

Background
Health effects of cereal β-glucans are often related to dose, size and viscosity without taking the specific molecular structure into account1.

We have studied the β-glucan molecular structure and physico-chemical functionalities of large-scale extracted barley and oat β-glucans prior to testing in a human intervention study.

This is the first time high performance anion exchange chromatography in combination with advanced spectroscopy (nuclear magnetic resonance, NMR and Raman) and multivariate data analysis has been used for studying complex relations contained in wide-ranging β-glucan data types2.

Large-scale extraction
High β-glucan mutant barley, mother barley and oat β-glucans were extracted by comparable protocols using hot water, enzyme assisted hydrolysis and ethanol precipitation.

Multivariate data analysis
Multivariate data analysis3 on all compositional, structural and functional β-glucan features demonstrated that the main variance among samples was primarily explained by block structural differences.

Molecular structure
The barley mutant proved to exhibit a significantly changed β-glucan block structure as found by high performance anion exchange chromatography. Low solubility of barley samples was an effect of a high DP3/DP4 ratio possibly constituted by longer repetitive DP3 sequences.

1H NMR spectroscopy
Signals of the β-1.4 and β-1.3 peaks can be used for building a prediction model of the DP3/DP4 ratio.

Raman spectroscopy
Systematic variation of the β-peak position is correlated to the β-1.4 and β-1.3 linkage ratio.

Conclusions
We succeeded in extracting fully comparable and reproducible high purity barley and oat β-glucan isolates with similar molecular masses and specific genotypic structural characteristics for the testing in a human intervention study on β-glucan health effects.

References