13 March 2018

**Understanding the mechanism of mixed-linkage glucan synthesis and accumulation in the cell wall of grasses**

New insights for maximizing sugar production in plants.

**The Science**

Grass species, which are among the major renewable feedstocks supporting biofuel production, can provide an abundant source of mixed-linkage glucan (MLG), a glucose polymer. Improving biofuel crops by increasing sugar yields requires a thorough understanding of biosynthetic mechanisms. In this study, GLBRC researchers demonstrated that MLG is present in the Golgi apparatus, in post-Golgi structures, and in the cell wall; these findings provide new insight on how to modify the localization of MLG synthase to maximize production of MLG.

**The Impact**

Increasing the content of easily digestible, six-carbon sugars can increase the yield of bioenergy crops. This study provides a greater understanding of the synthesis of the glucose polymer mixed-linkage glucan (MLG), including where it is made in cells and where it accumulates in plants. These findings have the potential to help overcome limitations to increasing MLG levels in plants and increase yield in bioenergy crops.

**Summary**

Mixed-linkage (1,3;1,4)-β-glucan (MLG) is a glucose polymer with high potential for the agricultural industry. MLG is present predominantly in the cell wall of grasses and is synthesized by cellulose synthase-like F or H families of proteins, with CSLF6 being the best-characterized MLG synthase. Although the function of this enzyme in MLG production has been established, the site of MLG synthesis in the cell is debated. In this study, GLBRC researchers tested the conflicting possibilities to establish a better understanding of the fundamentally important mechanisms of plant cell wall biosynthesis. Using immuno-localization analyses with MLG-specific antibody in *Brachypodium* and in barley, MLG was found to be present in the Golgi, in post-Golgi structures, and in the cell wall. Accordingly, analyses of a functional fluorescent protein fusion of CSLF6 stably expressed in *Brachypodium* demonstrated that the enzyme is localized in the Golgi. Furthermore, overproduction of MLG was also demonstrated in this study to cause developmental and growth defects in *Brachypodium*, as also occur in barley. Together, these results indicate that MLG production occurs in the Golgi similarly to other cell wall matrix polysaccharides, and supports the broadly applicable model in grasses that tight mechanisms control optimal MLG accumulation in the cell wall during development and growth. Future studies that build upon this work will enable the development of efficient strategies to overcome limitations in increasing MLG levels in plants, a promising strategy to increase yields of bioenergy crops.

**Contacts (BER PM)**

N. Kent Peters
Program Manager, Office of Biological and Environmental Research
kent.peters@science.doe.gov, 301-903-5549

**(PI Contact)**

Federica Brandizzi
Michigan State University
fb@msu.edu

**Funding**This work was funded primarily by the DOE Great Lakes Bioenergy Research Center (DOE BER Office of Science DE-FC02-07ER64494 and DE-SC0018409). Partial infrastructure support from the Chemical Sciences, Geosciences and Biosciences Division, Office of Basic Energy Sciences, Office of Science, US Department of Energy (award number DE-FG02-91ER20021) and AgBioResearch was also provided.

**Publications**

Kim, S.-J. *et al.* “In the grass species *Brachypodium distachyon*, the production of mixed-linkage (1,3;1,4)-β-glucan (MLG) occurs in the Golgi apparatus.” *The Plant Journal* (2018) [DOI: 10.1111/tpj.13830].

**Related Links**

<http://onlinelibrary.wiley.com/doi/10.1111/tpj.13830/full>

**PM Recommendation for SC Web Publication**