"Evolution of main chemical components content and monosaccharidic content of hemicelluloses in several lignocellulosic grass crops grown under different crop husbandry conditions"

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ABSTRACT

Cellulose and hemicelluloses are the most abundant structural polysaccharide in nature. Their optimal valorization in lignocellulose-based biorefineries requires a good knowledge of the contents available in various biomasses, and of their molecular composition. The composition and more specifically the monosaccharidic content (cellulosic glucan, xylan, arabinan, mannan, galactan and hemicellulosic glucan) were analyzed in several lignocellulosic grass crops: switchgrass (Panicum virgatum L.), tall fescue (Festuca arundinacea Schreb.), cocksfoot-alfalfa association (Dactylis glomerata L.-Medicago sativa L.). Cellulose and hemicelluloses contents were in the range 20.8-33.3 and 14.5-32.6 g (100gDM)-1, respectively, with lignin, total soluble sugars, proteins, and ash contents around 2.9-7.8, 2.0-21.7, 5.7-17.2 and 4.3-16.3 g (100gDM)-1, respectively. The main hemicellulosic components were, by order of decreasing importance, xylan 8.3-23.2 g (100gDM)-1, arabinan 2.12-4.10 g (100gDM)...
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Introduction

Switchgrass, tall fescue and ‘cocksfoot-lucerne’ association are promising perennial lignocellulosic grass crops as a source of cellulose and hemicelluloses in the field of bioenergy and biorefinery, owing to their high polysaccharides content and high biomass yields. Their optimal valorization in lignocellulosic-based biorefineries requires a good knowledge of the biomass composition, and especially of the molecular composition of hemicelluloses.

Biomass characterization

The main chemical components (cellulose, hemicelluloses, lignin, total soluble sugars, proteins and mineral compounds) and more specifically the monosaccharidic content (cellulosic glucan, xylan, arabinan, mannan, galactan and hemicellulosic glucan) were analyzed in several lignocellulosic grass crops: switchgrass (Panicum virgatum L.); cultivars: Cave in rock, Dacotah, Kanlow, Trailblazer, Blackwell, Shelter and Nebraska 28; late winter harvest) grown at Gembloux (Belgium), tall fescue (Festuca arundinacea Schreb., cultivars: Kora, Soni, Jordane, Perun and Hykor; 3 harvest cycles) grown at Gembloux (Belgium) and ‘cocksfoot-lucerne’ association (Dactylis glomerata L.-Medicago sativa L.; Nitrogen fertilization levels applied in June: 0, 50 or 100 kg N ha\textsuperscript{-1}; 3 harvest cycles) grown at Libramont (Belgium) in 2009.

Switchgrass cultivars

From spring to autumn, the relative xylan content decreased while the arabinan, galactan and hemicellulosic glucan contents increased, as observed for tall fescue because of an increased presence of alfalfa in the 2nd and 3rd harvest cycle.

Tall fescue cultivars and harvest cycles

‘Cocksfoot-alfalfa’ association nitrogen fertilization levels and harvest cycles

Conclusions

Cellulose and hemicelluloses are the major components of the dry matter. The major hemicellulosic components are, by order of decreasing importance, xylan, arabian, hemicellulosic glucan, galactan and mannan.

Plant species and harvest cycle has the most significant influence on the structural polysaccharide composition, while the influence of cultivar and nitrogen fertilization were only rarely significant.