

CARBOHYDRATE COMPOSITION OF GREEN AGRICULTURAL HERBACEOUS BIOMASS FOR ETHANOL CONVERSION: JERUSALEM ARTICHOKE

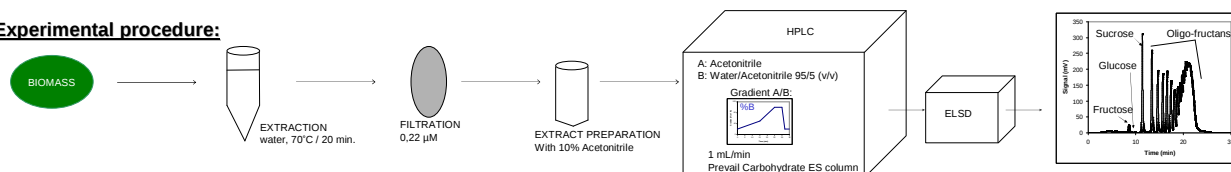
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Introduction: Jerusalem artichoke biomass consists mainly of structural polysaccharides, reserve polyfructans and soluble sugars that can be converted by micro-organisms to ethanol.

Aim: - To examine the composition of Jerusalem artichoke stalks and leaves, as well as tubers, to check their suitability for a dedicated ethanol conversion process.
- To investigate the influence of crop density and harvest period on biomass composition

Experimental procedure:



Stalk and leaves

Total carbohydrates composition

Evolution of carbohydrates over time (in Libramont)

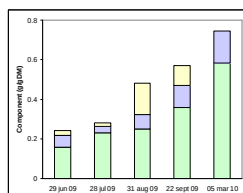


Figure 1a: Most of the plant biomass is made of structural polysaccharides. Soluble carbohydrates are up to 30% of the total carbohydrates in late summer, then decrease. Cellulose is the most important saccharide and increases over time.

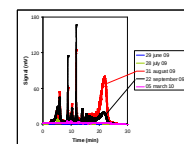
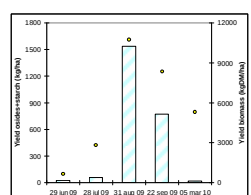
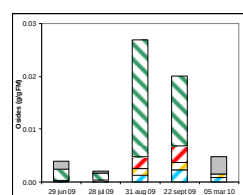


Figure 1b: Soluble sugar concentrations of stems and leaves is maximum between the end of August and the end of September with fructose 1.2 to 2.3 mg/g_{FM} (7.2 to 11.5 mg/g_{DM}), glucose 1.3 to 1.4 mg/g_{FM} (7.4 to 6.8 mg/g_{DM}), sucrose 2.5 to 3.1 mg/g_{FM} (13.8 to 15.5 mg/g_{DM}) and oligofructans 27 to 20 mg/g_{FM} (129 to 66 mg/g_{DM}).

The soluble sugars would enable to produce 10 to 15 g_{Ethanol}/kg_{FM}. The maximum yield is 1500 kg osides/ha (750 kg_{Ethanol}/ha) at the end of August.

Influence of crop density (19 October 2009 in Libramont)

Figure 2a: Density does not influence the proportion of total carbohydrates. Cellulose and soluble sugars represent 50% and 30% of total carbohydrates, respectively. The results are consistent with Figure 1a (end August).

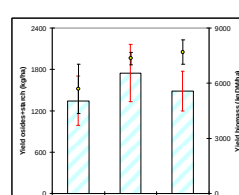
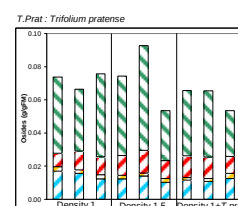
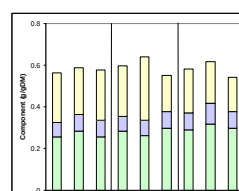


Figure 2b: Crop density doesn't influence soluble sugars concentration in stalks and leaves. The soluble sugars concentration of 0.07 g/g_{FM} (0.24 g/g_{DM}) would enable a ethanol concentration of 3.5% (w/w). The crop density increases slightly but not significantly the yield of soluble carbohydrate produced per hectare.

Tubers

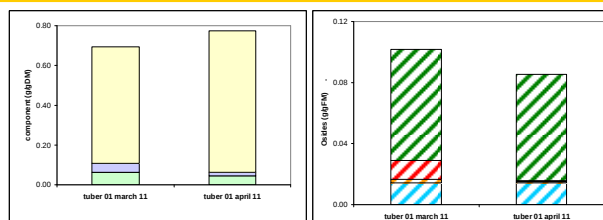


Figure 3 : Tubers consist mainly of oligo-fructans that can be hydrolyzed and fermented by microorganisms to ethanol. Production could reach 50 to 40 g_{Ethanol} / kg_{FM}. Color legend as defined in Figs. 1 and 2.

Interpretation and Conclusion

- Cellulose is the main carbohydrate in the aerial parts.
- Polyfructanes are the main fermentable carbohydrates. The highest level is available at the end of August in the aerial parts and later in the tubers.
- Expected ethanol productions range from 10 to 35 kg/t_{FM} for stems and leaves and 50 kg/t_{FM} for tubers.



This experimental work is financially supported by the Walloon region