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Engineering hemicellulose-lignin complexes? extraction for obtaining emulsion stabilizing hydrocolloids

AUTHORS

Henrik GRENMAN / ÅBO AKADEMI UNIVERSITY, BISKOPSGATAN 8, TURKU
Jussi RISSANEN / ÅBO AKADEMI UNIVERSITY, BISKOPSGATAN 8, TURKU/ÅBO
Lucas LAGERQUIST / ÅBO AKADEMI UNIVERSITY, BISKOPSGATAN 8, TURKU/ÅBO
Patrik EKLUND / ÅBO AKADEMI UNIVERSITY, BISKOPSGATAN 8, TURKU/ÅBO
Elina LIUS / UNIVERSITY OF HELSINKI, AGNES SJÖBERGIN KATU 2, HELSINKI
Maarit LAHTINEN / UNIVERSITY OF HELSINKI, AGNES SJÖBERGIN KATU 2, HELSINKI
Kirsi MIKKONEN / UNIVERSITY OF HELSINKI, AGNES SJÖBERGIN KATU 2, HELSINKI

PURPOSE OF THE ABSTRACT

The performance of hemicellulose-based compounds from lignocelluloses in the potential products is determined largely by the chemical composition and the structure of the molecules. The objective in the extraction processes has mostly been to obtain completely pure fractions of hemicellulose, lignin, and cellulose. However, a controlled mixed structure of the compounds can be an advantage in certain applications.

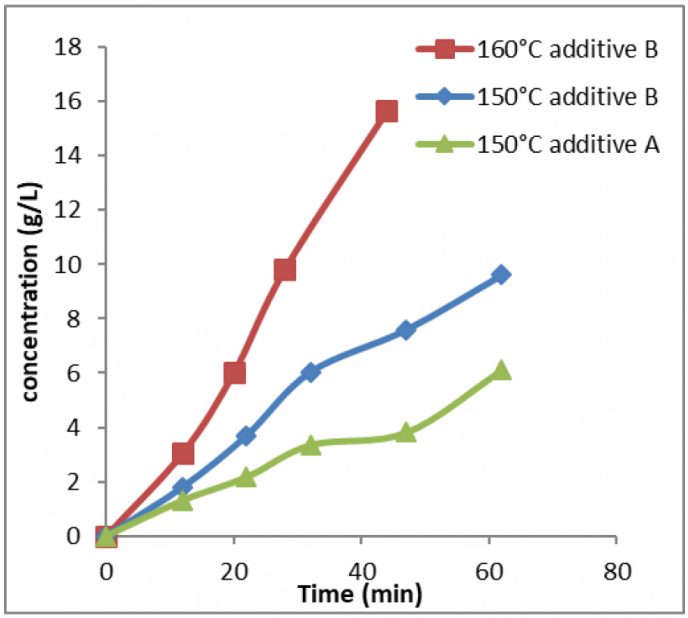
Recently researchers has shown, that galactoglucomannan (GGM) based compounds have the potential to replace the ?golden standard? food stabilizer gum Arabic (GA) in food, pharmaceutics, and cosmetics. [1, 2] In these studies, GGM displayed exceptional capacity to inhibit lipid oxidation and act as a multifunctional stabilizer, enhancing both the physical and oxidative stability of emulsions. The higher content of phenolic residues in GGM compared to GA was concluded to contribute to GGM's excellent oxidation inhibition capacity. The exact mechanisms behind the beneficial influence of lignin residues in the GGM are unclear, as is the influence of the structure and composition of the lignin-hemicellulose complexes (LCC) on their performance. The basic phenomenon has been established, but many of the details are in the dark.

In our recent study, hemicelluloses from spruce were extracted with pressurized hot water (PHWE) using a well separable additive, which is suitable for the alimentary and cosmetics industry. The results clearly demonstrated that the extraction rate was considerably enhanced with the additive (Fig. 1) and about 10-15% more lignin (Klason lignin in solid) was dissolved compared to normal PHWE. Moreover, the NMR results indicated that lignin stays covalently bound to the dissolved hemicelluloses forming amphiphilic water soluble LCC. The extraction method also influenced e.g. the molar mass of the obtained macromolecules as displayed in Figure 2. However, the detailed mechanisms of dissolution should be understood in order to be able to influence the properties of the extracted compounds by varying the experimental conditions.

The current interdisciplinary research focuses on building on a newly developed extraction method for enhancing hemicelluloses extraction, which enables tuning the lignin content and properties of the LCC. The complexes are utilized for emulsion stabilization studies in collaboration with specialists in alimentary research and emulsions. Different wood species combined with varying reaction conditions have been tested and their performance as emulsion stabilizers and anti-oxidizing agents was evaluated.

The work bridges the state of the art knowledge in the safely enhanced extraction of hemicelluloses-lignin compounds and the related reaction engineering (chemical engineering) and the utilization of the LCC for alimentary purposes (alimentary chemistry). Moreover, the potential utilization is by no means limited to the alimentary industry, but fields such as cosmetics and health products are highly viable.

FIGURES



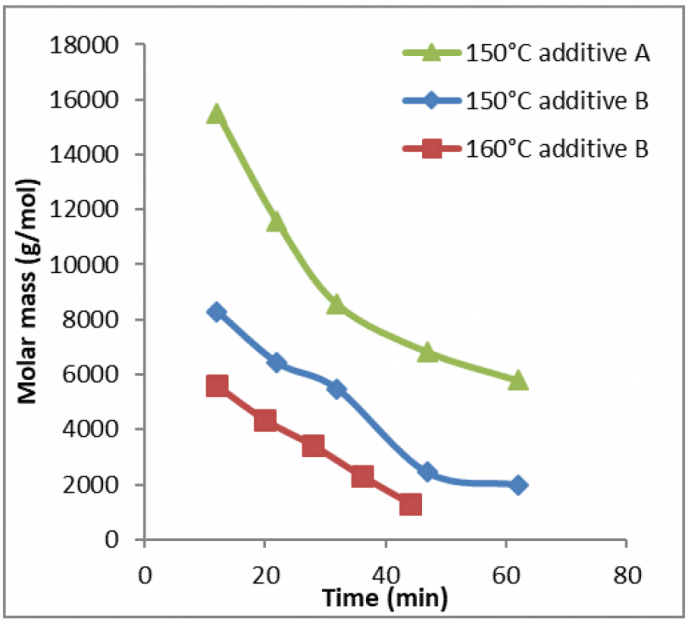


FIGURE 1

Fig 1

Figure 1. The enhancement of the extraction rate by selected additive.

FIGURE 2

Fig 2.

Figure 2. The influence of additive addition to the molar mass of the macromolecules.

KEYWORDS

Hemicelluloses-lignin complexes | extracion | wood | emulsifier

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