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Gembloux
Agro-Bio Tech

Le Corps professoral de

Gembloux Agro-Bio Tech - Université de Liège vous prie

de lui faire l'honneur d'assister à la défense publique de la dissertation originale que

Monsieur GILLET Sébastien,

Titulaire d'un diplôme de bioingénieur chimie et bio-industries,

présentera en vue de l'obtention du grade et du diplôme de

DOCTEUR EN SCIENCES AGRONOMIQUES ET INGENIERIE BIOLOGIQUE,

le 28 juin 2018, à 14 heures précises (personne ne sera admis après cette heure),

en l'auditorium CG (Chimie Générale, bât. 8),

Passage des Déportés, 2, à 5030 GEMBLOUX.

Cette dissertation originale a pour titre :

« Etude des relations entre la structure des galactomannanes de caroube et leurs propriétés fonctionnelles ».

Le jury est composé comme suit :

Présidente : Prof. M.-L. FAUCONNIER : Professeur ordinaire,
Membres : Prof. C. BLECKER (Promoteur), Prof. F. DELVIGNE, Dr M. DELEU, Prof. A. RICHEL, Prof. R. KAROUI (Université d'Artois, France), Prof. I. CYBULSKA (UCL).

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Summary

Crude locust bean gum was purified and extracted in a fractionated and subtractive manner at two different temperatures (25 ° C and 80 ° C) in order to obtain two distinct fractions (GM25 and GM80). These were structurally characterized. Both fractions have close – but different – structures. Thus, the GM80 fraction differs from the GM25 fraction by longer chain lengths. GM80 is also less substituted in galactose and has an alternation of unsubstituted sequences and densely substituted regions on the main chain of the polymer (GM25 distribution of substituents is slightly more homogeneous).

The present work highlighted that these relatively small structural differences within the same initial polysaccharide generate very different physicochemical behaviors in aqueous media, at different observation levels (diluted solutions, concentrated solutions and gel state). Information analysis has demonstrated in particular that specific interactions (alkali-labile and non-covalent) exist between the galactomannan chains, mainly for the GM80 fraction. These originate from the presence of a larger number of unsubstituted regions that interact between them. The GM25 fraction is more influenced by its molecular weight. These same interactions within the GM80 fraction decrease their hydrodynamic radius and intrinsic viscosity in the dilute regime but promote the appearance of a concentrated hyperentangled network characterized by a greater dynamic viscosity and viscoelasticity.

By studying also the reaction properties under subcritical conditions (assimilated to acid hydrolysis conditions), this work has also demonstrated that the GM25 and GM80 fractions generate different kinetics of hydrolysis. A greater degree of galactose substitution seems to preserve - or at least slow down - the auto-hydrolysis and the breakdown of glycosidic bonds. Galactosyl substituents are yet more easily hydrolyzed and released into the medium. This seems to follow a statistical law, but it is also strongly influenced by the anomeric effect. The GM80 fraction also released more galactose than the GM25 fraction, which initially contained more. Again, the reasons seem to be related to the fine structure of the polymers, and in particular to the densely substituted areas of the GM80 fraction. These would generate a steric hindrance that weakens the galactose bonds while the unsubstituted regions would generate a conformation (hydrophobic effect) which exposes the galactosyls more importantly to the drastic environment.