Tragacanth Gum: Structural Composition, Natural Functionality and Enzymatic Conversion as Source of Potential Prebiotic Activity - DTU Orbit (31/03/2019)

Tragacanth Gum: Structural Composition, Natural Functionality and Enzymatic Conversion as Source of Potential Prebiotic Activity

Gum tragacanth derived from the plant (Astragalus sp.) has a long history of use as a stabilizing, viscosityenhancing agent in food emulsions. The gum is mainly produced in the Middle East, and permitted for food use in the US as well as in Europe (E-number E413). Gum tragacanth is known to confer very high viscosities when in aqueous solution, and is described as a complex, highly branched, heterogeneous hydrophilic polysaccharide. The gum contains pectinaceous arabinogalactans and fucose-substituted xylogalacturonans. The objective of this PhD study were to evaluate tragacanth samples from six species of Iranian Astragalus for their emulsion stabilizing effects and their detailed chemical composition in order to examine any possible correlation between the make-up and the emulsion stabilizing properties of gum tragacanth. Also, enzymatic modification of highly fucose content of tragacanth gum and separation via membrane technique to get different molecular size. Furthermore, examination of compositional structure and effect of different molecular size on potential prebiotic was evaluated.

The first part of the present study was selected of six different species of Astragalus and exudates of gum and fractionated by centrifugation to soluble and insoluble. To examine correlation between composition structure, sugar composition and methoxyl and acetyl content was determined. The six gum samples varied with respect to their levels and ratios of watersoluble and water-swellable fractions, their monosaccharide composition, methoxylation, and acetylation degrees. Emulsion and rheological properties of different gum solution was assessed with WPI as an emulsifier in protein base emulsion and correlation of each composition on emulsion stability was established. Tragacanth gum solution added in emulsion and without emulsion showed shear thinning properties in all gums. The emulsion stabilization effect correlated linearly and positively to the methoxylation degree, and galacturonic acid content of the gums, but not to acetyl or fucose content. A particularly high correlation was found between methoxyl level in the soluble gum part and emulsion stabilization.

The results of this work provide some important clues to the emulsion stabilization mechanisms in relation to the structure composition of tragacanth gums.

From our knowledge and many research for application of this gum in food industry and unique properties of this gum with arabinogalactan and fucose-substituted xylogalacturonans in the structure of we decided to evaluate bioactivity of this gum. To date, different commercial of prebiotic compound available but still new compound is needed and interested. The main process for the production of prebiotic is enzymatic process. Thus, the next study of work was using commercial pectinolytic enzyme to get different molecular size and purified with membrane technique and get three different fraction: HAG1 < 2 kDa; 2 kDa< HAG2 < 10 kDa; HAG3 > 10 kDa. HPAEC results shown that these three fractions varied with respect to composition and HAG1 and HAG2 were enriched in arabinose,galactose, and galacturonic acid, but low in fucose and xylose; whereas HAG3 was high in xylose, fucose and galacturonic acid, but low in arabinose and galactose. The structural composition of different fractions with linkage analysis shown that the structure of gum tragacanthfractions was different and included 1,4-bonded galacturonic acid backbone with terminally linked fucose and (1,2-linked xylose, as well as terminally linked xylose called fucoxylogalacturonan. In addition, the presence of (1,4-galactose linkages and 1,5 Ara linkage presumably correspond to arabinogalactan-derived galactan. Determination of prebiotic effect of different fraction in vitro were assessed on seven different probiotic strains in single culture fermentations on: Bifidobacterium longum subsp. longum (2 strains), B. longum subsp. infantis (3 strains), Lactobacillus acidophilus, B. lactis, and on one pathogenic strain of Clostridium perfringens. The fractions HAG1 and HAG2 consistently promoted higher growth of the probiotic strains than HAG3, especially of the three B. longum subsp. infantisstrains, and the growth promotion on HAG1 and HAG2 was better than that on galactan (control). HAG3 completely inhibited the growth of the Ct. perfringensstrain.

In summary of this study:
- Emulsion stabilization of the gum is related to the gum composition and structure, and mainly galacturonic acid content and degree of esterification are important
- low molecular size oligosaccharides produced enzymatically has higher potential prebiotic activity than longer chain gum saccharides
- Tragacanth gum can be a new source for development of innovative functional foods with health claims

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