INDUSTRIAL BY-PRODUCTS AS A SOURSES HIGH-VALUE POLISACCHARIDE COMPOUNDS

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Abstract

Agricultural wastes and industrial by-products represent a major origin of carbohydrates. Obtaining hemicelluloses such as arabinoxylan and pectin from these sources presents attractive utilization of waste material. In additions, these polysaccharide products gained much attention because of their excellent biocompatibility, biodegradation and non-toxicity as well as extensive spectrum of their biological and functional properties. Polysaccharides with a molecular weight of about 20 kDa were isolated from the wheat chaff and sugar beet shreds. Obtained pectin produced gel coacervats with gelatin while arabinoxylan from wheat chaff formed a gel by mixing with β-glucan in the presence of laccase. Both of prepared gels under simulated gastric and intestinal conditions indicated a strong stability. Furthermore, biological investigation of extracted polysaccharides revealed good antioxidative activities.

Introduction

A large amount of waste is produced by agro-industrial sector but maximum benefit has not yet been attained from it [1]. Sugar beet shreds present an industrial by-product while wheat chaff is generated during harvest. They are usually used as animal feed rather than sources for extraction of valuable components for human use. Hence, there is a need for improved technologies that would be able to enhance utilization of all high-value components from such waste materials and reduce cost of processing. In this context, considerable interest has been focused during the last years on polysaccharides from agricultural and industrial by-products as desirable alternatives to conventional petroleum-based fuels. However, polysaccharides have a wide range of other features such as biological and functional activities.

Therefore, the aim of this study was to investigate application of wheat chaff and sugar beet shreds as sources of antioxidant and functional carbohydrates.

Experimental

Arabinoxylan was isolated from wheat chaff by alkaline extraction, while pectin was isolated by hot acid extraction from sugar beet shreds. Following the extraction, polysaccharides were precipitated with ethanol and dried. Molecular mass of the isolated polysaccharides was determined viscosimetrically. Arabinoxylan gel was obtained by laccase crosslinking in 4% polysaccharide solution. Pectin gel was formed by coacervation of 0.5% pectin and 1.0% gelatin solution at pH 4. Prepared gels were dried at room temperature. The stability of dry gels was investigated in simulated gastrointestinal conditions. For 2 h gels were immersed in simulated gastric fluid (SGF) at pH 2, followed by 10 h in simulated intestinal fluid (SIF) at pH 7. The stability was monitored in defined time intervals as the amount of dissolved reducing sugars from the arabinoxylan gel or as the amount of dissolved gelatin from pectin based gel. ABTS method was applied to estimate antioxidant potential of extracted polysaccharides.

Results and discussion

Pectin was isolated from sugar beet shreds by acid extraction and subsequently precipitated with ethanol, washed in water, partially purified by ultrafiltration and dried with yield 202.5 mg/g while extraction yield of arabinoxylan from wheat chaff at alkaline conditions amounted 60 mg/g. The molecular weight of isolated polysaccharides was similar (Table 1). Both of obtained polysaccharides could form gel. Arabinoxylan formed gel using laccase for crosslinking of ferulic acid while the β-glucan was used for increase in gel stiffness [2]. Formation of pectins gel included interaction between negatively charged pectin polysaccharides and positively charged gelatin at acidic pH [3]. Both of formed gel structures showed good stability under simulated intestinal fluid while degradation in gastric fluid was more noticeable (Figure 1). In this study, ABTS *in vitro* assay was applied to evaluate antioxidant potential of polysaccharides extracted from wheat chaff and sugar beet shreds. As showed in Figure 2, arabinoxylan and pectin exhibited dose-dependent behavior of antioxidant activity.

Table 1. Yield and molecular weight of extracted polysaccharides

	Y(mg/g)	MW (g/moL)
Arabinoxylan	60.0	29,000
Pectin	202.5	22,200

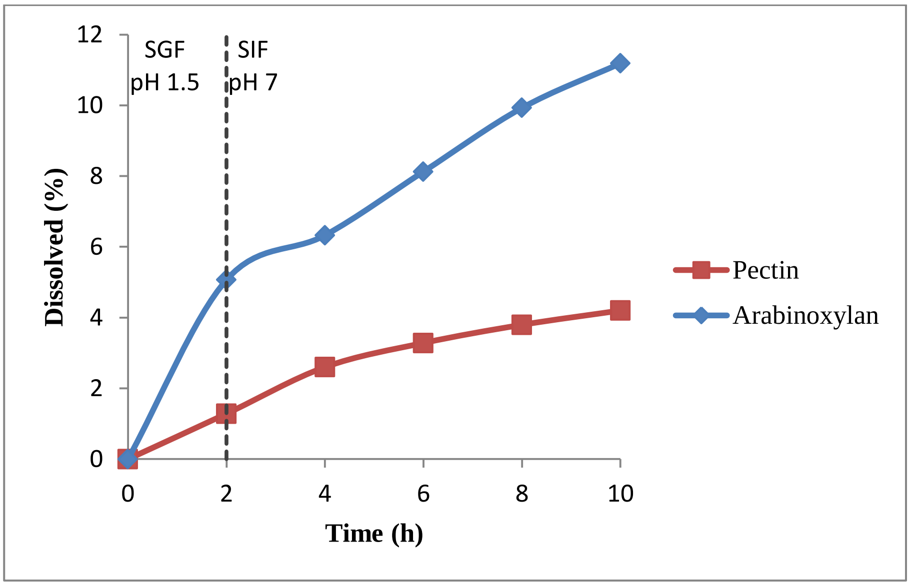

Figure 1. Stability of gels in gastrointestinal conditions

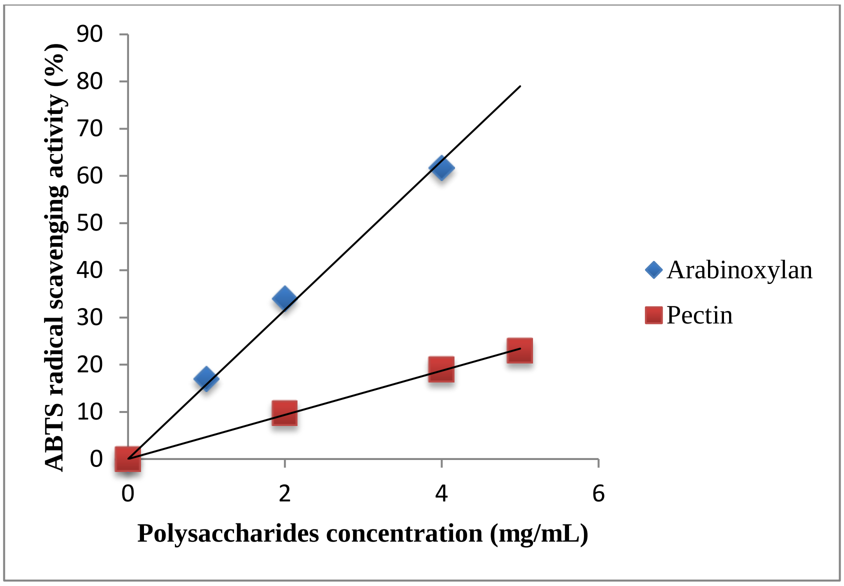

Figure 2. Antioxidant activity of extracted polysaccharides

Conclusion

Arabinoxylan and pectin could be novel bio-sources of gelling agents and antioxidants with potential added value when applied as functional food and for encapsulation of therapeutics.

Acknowledgements

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References

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