

Waste Management in the Sugar Industry: Study of Pectin Extraction from Sugar Beet Flakes by Conventional and Non-conventional Techniques

Florina Dranca and Silvia Mironeasa

Faculty of Food Engineering, Stefan cel Mare University, Suceava, Romania

Abstract

Sugar industry generates large amounts of by-products that can be used in various applications. Through the production of refined sugar from sugar beets, two main by-products are obtained - beet pulp in the form of fibrous flakes that result from the extraction of sugar, and molasses, which is a dark-colored, viscous, and liquid by-product of the production process. In general, sugar beet flakes are used in animal feed, while molasses is used for alcohol production, in animal feed or as a medium for obtaining yeast biomass. Sugar beet flakes composition is mainly made up by three major polysaccharides - cellulose, hemicellulose and pectin, together with small amounts of fat, protein, ash and lignin. As a result, the flakes generated from sugar beet processing in the sugar industry were considered as raw material for pectin production. Pectin extracted from sugar beet is one of the main types of pectin available on the market, mostly due to its properties and the availability of source material. Pectin represents a group of polysaccharides naturally found in the plant cell walls; pectin recovered from plant materials, mainly citrus peel, apple pomace and sugar beet flakes, has industrial and commercial value as thickening, stabilizing and gelling agent. The general process of pectin production, irrespective of the plant material used as pectin source, comprises the following main steps: pretreatment of plant material, extraction, and a post-extraction stage (precipitation and purification of pectin). By focusing on the extraction stage of pectin production, the aim of this research was to compare different conventional and non-conventional extraction techniques applied to sugar beet flakes, and to investigate the influence of the extraction conditions on the yield of the process and the purity of the extracted pectin. This represents the first study on use of sugar beet flakes resulted from sugar processing in the north-east region of Romania, by one of largest sugar producers in Europe, as pectin source. For conventional extraction with citric acid, the parameters that were varied were temperature, pH, solid-to-liquid ratio (SLR), and time. In the case of the non-conventional extraction techniques, the following parameters were varied: for microwave-assisted extraction - microwave power, pH, SLR and time, and for ultrasound-assisted extraction - ultrasonic amplitude, pH, SLR and time. Overall, better results in terms of yield were achieved by conventional citric acid extraction, which resulted in a pectin yield of about 20%. The highest purity of pectin, expressed as galacturonic acid

content, was obtained for pectin extracted by ultrasound-assisted extraction and exceeded 90 g galacturonic acid/100 g pectin. Following the optimization of the extraction conditions of each technique, pectin extracted from sugar beet flakes will be used to develop new food products through its incorporation into the composition of gluten-free pasta.

Keywords: sugar beet flakes, pectin, extraction

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