ISOLATION OF ARABINOXYLANS FROM WHEAT BRAN BY ALKALINE/HYDROGEN PEROXIDE AND AQUEOUS EXTRACTION IN A SMALL TECHNICAL SCALE UP TO 150 KG OF SLURRY

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Wheat bran is an important by-product of the wheat milling industry and accounts for 11 to 19% of the grain. It mainly consists of dietary fibre (43-53%). The fibre fraction includes arabinoxylans (AX) (38-55%), cellulose (16-30%), lignin (5-20%) and other nonstarch polysaccharides (Rose and Inglett, 2010; Maes and Delcour, 2001; Hollmann and Lindhauer, 2004). Depending on their molecular masses, AX may have different health benefits in the large intestine (Gemen, de Vries and Slavin, 2011). Process simulations indicated that an AX product of 80% purity could be produced at costs of around 3.7-4.5 £/kg (Misailidis et al, 2009).
The aim of this study was to develop a small technical process in a scale up to 150 litres of slurry and to determine important parameters of the process steps necessary for developing a process for an economic production of AX. Experiments were carried out in a laboratory and in a small technical scale up to 10 kg of wheat bran in one batch. Initially the starch was mechanically separated at room temperature by aqueous dispersion and wet sieving. Then alternatively three different processes were carried out by always using this destarched wheat bran.

First, the AX were extracted from the wheat bran (3.46 kg before destarching) in a small technical scale by alkaline/hydrogen peroxide at 60°C followed by centrifugation, ultra- and diafiltration, ethanolic precipitation of AX and drying. The purity was 69.8% AX in d.m. and the xylose/arabinose-ratio was 2.38.

Second, the wheat bran was extracted with water only in a laboratory scale (400 ml autoclave) at temperatures in the range of 147-163°C with extraction times of 0.5-2.0 h. The resulting suspension of the autoclave-extraction was centrifuged and the AX were isolated from the supernatant by ethanolic precipitation using a mass ratio of ethanol (96%) to supernatant of 3.17 to 1. The precipitated AX were then centrifuged and freeze dried. The AX content was 47.3-58.6% in d.m..

Third, the wheat bran (10.00 kg before destarching) was extracted in a 150 litre pressure-reactor with water only at 147-163°C for 0.5-1.0 h. The dispersions were sieved (250µ), the sieve residue washed, the liquid phase then alkalinely (pH=10.0) bleached with H_2O_2 at 23-49°C and concentrated and purified by membrane filtration using polysulfone membranes with a molecular cut off of 10.000 g/mol in a 1.05 sqm plate and frame process unit at 55°C. Starting with approx. 160 kg, a concentration up to 45 kg was possible. The resulting AX concentrate suspension was then spray dried at 190/90°C. By this process the lowest AX content (37.6-45.1% in d.m.) in the final product was obtained.

The molecular masses of the AX isolated in the laboratory scale strongly depended on the extraction conditions and varied in the range of M_w = 11.100 to 220.000 g/mol. With increasing extraction time and temperature the polymeric carbohydrates were distinctly degraded. The molar masses M_w of AX extracted under alkaline/hydrogen peroxide conditions were about 70.200 g/mol.

Keywords: Arabinoxylan, wheat bran, isolation, process parameter

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