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Effects of pretreatment of wheat bran on the quality of protein-rich residue for animal feeding and on monosaccharide release for ethanol production

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HIGHLIGHTS

- Protein-rich residues from bioethanol production are used for animal feeding.
- Wheat bran was pretreated with increasing severity and hydrolysed enzymatically.
- A higher severity did not enhance fermentable sugar yield from wheat arabinoxylan.
- Increasing the temperature above 140 °C decreased the nutritional quality of protein.
- A lower pH during pretreatment increased digestibility of residual protein *in vitro*.

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ABSTRACT

The effects of hydrothermal conditions for pretreating wheat bran on the quality of residual protein for animal feeding, and on monosaccharide release for ethanol production were studied according to a $4 \times 2 \times 2$ design with the factors, temperature (120, 140, 160, and 180 °C), acidity (pH 2.3 and 3.9), and retention time (5 and 10 min). Temperature affected the quality of residual protein for animal feeding. Pretreatment at 120 and 140 °C did not affect *O*-methylisourea-reactive lysine in protein-rich wheat bran residue, although total lysine decreased with increasing temperature at pH 2.3. At temperatures higher than 140 °C, reactive lysine decreased and melanoidins, furfural and 5-HMF increased. Lower acidity during pretreatment at 120 and 140 °C increased the digestibility of the residual wheat protein *in vitro* by 36%. Pretreatment conditions did not substantially affect the release of monomeric xylose and arabinose by hemicellulases, which suggests that arabinoxylans in wheat bran are well accessible for enzymes.

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1. Introduction

Hydrothermal pretreatments in combination with an acid catalyst are established methods for the hydrolysis of (arabino)xylans from ligno-cellulosic materials (Mosier et al., 2005). Such treatments are commonly used to increase the availability of pentoses from non-food biomass like wheat bran and corn fibers for ethanol production (Margeot et al., 2009). Arabinoxylans are a major constituent in wheat bran (22–25% w/w) from which monomeric arabinose and xylose can be released after pretreatment and enzymatic hydrolysis (Hahn-Hägerdal et al., 2007; Hausser et al., 2011). Apart from ethanol, the fermentation process also yields large amounts of protein-rich residue, mainly originating from the proteins in corn and wheat kernels. This residue can be used as a valuable ingredient in animal feeds and may replace high-value protein sources currently used in the animal feed industry (Laser et al., 2009) such as soybean meal, potato protein and animal-derived proteins.

However, the nutritional quality of the protein in the residue may be reduced due to hydrothermal pretreatment by racemization (Friedman, 1999b) and cross-linking (Friedman, 1999a) of

Abbreviations: CS, combined severity; CV, coefficient of variation; DM, dry matter; 5-HMF, 5-hydroxymethyl-2-furfural; MRP, Maillard reaction product; OMIU, *O*-methylisourea; RT, retention time.

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