Effects of milling and cooking processes on bioactive benzoxazinoids in wheat and rye

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Introduction

Benzoxazinoids are plant secondary metabolites found in cereals e.g. wheat, maize and rye as well as in some dicot plants. These metabolites are divided into three groups based on their chemical structures: (1) benzoxazolinones: 2-benzoxazolinone (BOA) and 6-methoxy-2-benzoxazolinone (MBOA), (2) lactams: 2-hydroxy-1,4-benzoxazin-3-one (HBOA) and 2-hydroxy-7-methoxy-1,4-benzoxazin-3-one (HMBOA) as well as their respective 2-D glucosides; and (3) hydroxamic acids: 2,4-dihydroxy-1,4-benzoxazin-3-one (DIBOA) and 2,4-dihydroxy-7-methoxy-1,4-benzoxazin-3-one (DIMBOA) along with their corresponding 2-D glucosides (Fig 1). Dihydroxyls of DIBOA and HBOA (Fig 1) are provisionally characterized. Benzoxazinoids have been investigated for their role in plant defense against pathogens. Rye is an important cereal crop as well as food component in northern and eastern Europe and contains high amounts of benzoxazinoids compared to wheat. Benzoxazinoids have been studied for their health-related effects e.g. as anti-cancer, anti-allergy, appetite suppression, and weight loss factors.

Aims

1) To investigate the distribution of benzoxazinoids in different seed fractions obtained during milling of wheat and rye
2) To investigate the effect of various pretreatments on benzoxazinoids transformations in rye-based cereal products available in a supermarket.

1). Benzoxazinoids distribution among seed fractions in wheat and rye

Wheat and rye fractions (table 1) were obtained from Lantmännen (Swedish food company). Wheat fractions were obtained from a mixture of seven different cultivars mixed in different ratios (Eliis, Boomer, Ollivin, Opus, Akteur, Gnejs, Triso, Okand 39;36:18:3:1:1:1), whereas for rye 95% of seeds were from the Evolo cultivar. Samples were extracted with 80% methanol, 1% acetic acid and 19% water (v/v) on Accelerated solvent extractor (ASE 350). Diluted samples were analysed on MRM mode on an Applied Biosystem 3200 Q Trap LC-MS.

Results

Discussion

Our results (1) showed that the germ contains high benzoxazinoid concentrations in wheat compared to other seed fractions. In rye, the bran showed high levels of benzoxazinoids. It can be due to the mixing of germ material in the bran fraction during the milling process. DIBOA-di-hexose and DIBOA-glc, DIBOA, HBOA-di-hexose and HBOA-glc are the major constituents of total benzoxazinoids contents.

Pretreatment of breakfast cereals during cooking (2) had high impact on the levels of benzoxazinoids. In case of pearled rye, soaking influenced the concentrations of total benzoxazinoids e.g. hydroxamic acids and lactams. A threefold decrease in DIBOA-di-hexose and HBOA-di-hexose concentrations; a fivefold increase in DIBOA-glc and HBOA; and a twenty-fold increase in DIBOA and HBOA-glc was observed. In rye flakes, boiling showed a stronger increase in benzoxazinoids concentrations than soaking. Considerable amounts of total benzoxazinoids were also leached out into the water during soaking and boiling. Further analysis will be done to study effects of other pretreatments (malting and fermentation) during bread making etc, for production of food with high amounts of potentially health promoting compounds.

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