Prebiotic effects of cereal-derived arabinoxylans and their hydrolysates

Prebiotic effects of arabinoxylan oligosaccharides

Identification

Key words  cereal, arabinoxylan, AXOs, arabinoxylan oligosaccharide, xylooligosaccharides, prebiotic, health, dietary fibre

Latest version  2011/12/16

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How does it work?

Primary objective  prebiotics derived from cereal arabinoxylans (AX)

Working principle  Arabinoxylan oligosaccharides (AXOS) are low molecular mass hydrolysis products of the arabinoxylans (AX), one of the major cereal cell wall components and dietary fibre fractions.

AXOS can be considered prebiotics (= non-digestible food ingredients that beneficially affect the host by selectively stimulating the growth and/or activity of one or a limited number of bacteria in the colon, thereby improving host health) as they meet the three criteria laid out by Gibson et al. (2004)

• They are resistant to gastric acidity, hydrolysis by mammalian enzymes and to gastrointestinal absorption
• They are fermented by intestinal microbiota and short chain fatty acids (associated with lower gut pH, better bio-availability of calcium and magnesium and suppression of potentially harmful bacteria) are formed in this process
• They selectively stimulate the growth and/or activity of beneficial intestinal bacteria (in contrast to the original compound, arabinoxylan)

AXOS are formed in the large intestine by AX-degrading enzymes from some colonic microbiota. They are also generated in processed cereal-based foods such as bread, pasta, cookies and beer, through interaction of endoxylanases with the AX present. These endoxylanases can be (i) endogenous, (ii) originating from contaminating microorganisms, (iii) originating from purposively added microorganisms (e.g. sourdough cultures), (iv) purposely added in purified form from microbial enzyme preparation to increase the loaf volume or to increase the filterability of beers. For instance, enzymic degradation of wheat flour arabinoxylan (AX) by the hyperthermophilic xylanase B from Thermotoga maritime (rXTMB) occurs during bread making. Further increase in bread AXOS levels can be achieved by combining rXTMB with xylanases from Pseudalderomonas haloplanktis or Bacillus subtilis. Assuming an average daily consumption of 180 g of fresh bread, the bread AXOS levels suffice to provide a substantial part of the AXOS intake leading to desired physiological effects in humans. (4). Alternatively, AXOS can be supplemented in bread to increase its nutritive value. These AXOS can be produced from AX-rich plant materials by autohydrolysis under high pressure and temperature conditions or by enzymic hydrolysis using endo-β-1-4-xylanases (1).

Images
**Additional effects**
EFSA concluded that a cause and effect relationship has been established between the consumption of arabinoxylan produced from wheat endosperm and reduction of post-prandial glycaemic responses (3). Combination of hyperthermophilic xylanase B from Thermotoga maritime with xylanases from Pseudoalteromonas haloplanktis or Bacillus subtilis for in situ AXOS production synergistically increases the specific bread loaf volume (4).

**Important process parameters**
- type of endoxylanase used (functional stabilities, substrate specificities and inhibition sensitivities), time, temperature, extraction conditions

**Important product parameters**
- hard wheat cultivars contain more arabinoylans than the soft wheat cultivars (2)

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**What can it be used for?**

**Products**
- bread, cookies, pasta, beer, muesli, cereals, or probiotic drinks and other drinks based on cereals

**Operations**
- baking, brewing, extrusion

**Solutions for short comings**
- Improved health benefits from cereal products

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**What can it NOT be used for?**

**Products**
- For in situ production, AX need to be present (i.e. only cereal-based foods). However, AXOS can also be added.

**Operations**
- no information

**Other limitations**
- Functional stability (temperature) and inhibition sensitivity of the xylanase can limit the formation of AXOS.

**Risks or hazards**
- Some xylanases have been shown allergens, making them a possible health risk for bakery workers (6)

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**Implementation**

**Maturity**
- Maturity
  - Xylanases are already used in the baking industry for leavening purposes. The formation of prebiotic AXOS by the proper selection of xylalanses is an additional beneficial effect.

**Modularity**
- supplementation of xylanase during mixing

**Consumer aspects**
- No specific information is available on the attitudes of consumers towards prebiotics, but a positive one can be expected.

**Legal aspects**

**Environmental aspects**
- none
Facilities that might be interesting for you

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<tr>
<td>Auditorium IRTA</td>
<td>IRTA</td>
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<td>Clean room – Histocell</td>
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<td>Video observation system for market research and product development tasks - Keki</td>
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Further Information

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<td>6. Merget, R., Sander, I., Rauf-Helmsotth, M., Baur, X. (2001) Baker's asthma due to xylanase and cellulase without sensitization to alpha-amylase and only weak sensitization to flour. International Archives of Allergy and Immunology, 124, 502-505 .</td>
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Source: