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

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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 Pseudalteromonas 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).
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)

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

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)

Implementation

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

Modularity /Implementation  
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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<td>Clean room - Histocell</td>
<td>Noray</td>
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<td>Video observation system for market research and product development tasks - Keki</td>
<td>NAIK EKI</td>
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Further Information

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6. Merget, R., Sander, I., Raulf-Heimsoth, 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.

Source: