Physical and enzymatic treatments for obtaining water extractable arabinoxylans from corn bran

Maria Julia Spotti, Owen Jones, Bradley Reuhs, Bruce Hamaker and Osvaldo Campanella
Whistler Center for Carbohydrate Research

INTRODUCTION
Arabinoxylans (AX) are non-starch polysaccharides found in cell walls of cereals (Sauleau et al., 1995). The quantities of extractable arabinoxylans in corn fiber are around 60-70% of the dry weight. The material also contains about 20% cellulose, 4% phenolic acids and 2% protein (Doner & Johnston, 2001). Even though AX in corn bran can be water-extractable (WE) or water-unextractable (MU), structural investigations of corn bran AX have been mainly restricted to WU-AX (Kale, Hamaker, & Campanella, 2013). Since AX in corn bran are physically and chemically associated with each other and with other cell wall components, such as lignin and cellulose, most of them can only be extracted with alkaline media. However, this may result in the production of hazardous waste. The water extraction of arabinoxylans from corn fiber could be more economically convenient and produce less toxic waste than the alkaline extraction process (Escarnot et al., 2012). The objective of this research is to determine the chemical structure of water soluble arabinoxylans extracted from corn bran using physical treatment (high shear homogenizer (ultraturrax) (CU)) alone or in combination with ultrasound (CUU) and enzymatic treatment (endoxylanase enzyme from Novozyme (CE)) for obtaining water extractable arabinoxylans in corn fiber.

RESULTS

Both treatments showed considerable amount of glucosyl residues, remaining studying how much is in monomeric form. Arabinosyl and xylosil accounted for 30% of all the residues.

CONCLUSION

Although the physical treatments improved the yield of arabinosyl and xylosyl residues (CU and CUU compared with CE), much of glucose is being released with those treatments. The use of enzyme also produced samples with a high concentration of glucose. The use of ethanol for arabinoxylan precipitation, along with other methods, will be studied in order to increase the arabinoxylan yield and decrease the amount of glucose released from cellulose.

MATERIALS AND METHODS

Corn Bran (CB)

1. DPC + Ultrasound (U)
2. DPC + Ultrasound + Protease (CU)
3. Destarching and proteolysis (DPC)
4. Destarched and proteolized Corn Bran (DPC)

Physical treatment

1. DPC + Ultraturrax (U)
2. DPC + Ultraturrax + Protease (CU)

Enzymatic treatment

1. DPC treated with Ultraturrax (U)
2. DPC treated with Enzyme (CE)

Physical/Enzymatic treatment

1. DPC treated with Ultraturrax (U) and Enzyme (CE)
2. DPC treated with Enzyme (CE) for 24 h and U and Enzyme for 40 min

Composition analysis

1. CE, CUE, CUU
2. CE, CUE, CUUE

RESULTS

Fig 1. Composition analysis by AA-GC of water soluble AX applying:

- Centrifugation (Supernatant)
- Protease: α-amylase
- Centrifugation (Precipitate)
- DPC + Ultraturrax
- Ultraturrax

Fig 2. Composition analysis by AA-GC of products of enzymatic treatment with hydrolysis.

All the procedures showed the same profile of glycosyl residues. The previous physical treatment (CUE and CUUE) seems not to affect the composition.

All the samples at 5%w/v had almost the same viscosity that water at 25 °C. The yield of these samples could not be determined since all these enzymatically treated samples could not be freeze dried: they melted during the process, probably because of the high content of glucose and other sugars in the monomeric form.

Fig 3. Composition analysis by AA-GC of products of enzymatic treatment without hydrolysis.

Simple sugars in CE, CUE and CUUE are glucose, and that most of the arabinose and xylose residues are present in polymeric form.

Fig 4. Viscosity of 5% w/v solutions enzymatically treated.

Viscosity measurements of the 5% w/v solution enzymatically treated were done in a AR-2 rheometer, using cone cylinder geometry.

REFERENCES


FUTURE WORK

The initial water extraction will be performed at different temperatures.

In order to get oligosaccharides and polysaccharides, purification and isolation of different fractions will be performed by:

- Ethanol precipitation/fractionation
- Dialysis with different MWCO membranes
- Rheological behavior
- Starch and protein content
- Molecular weight
- Yield
- Particle size

Then, analysis each fraction will be analyzed by

- Composition analysis
- Linkage analysis
- Molecular weight
- Particle size
- Rheological behavior
- Starch and protein content
- Molecular weight
- Yield
- Particle size