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Processing of oat dietary fibre for improved functionality as a food ingredient

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A dry fractionation process was developed based on defatted oats. Lipid removal by supercritical carbon dioxide extraction enabled concentration of the main components of oats: starch, protein, lipids and cell walls into specific fractions. A defatted oat bran concentrate (OBC) with 34% beta-glucan was obtained after two grinding and air classification steps. Ultra-fine grinding was needed to further dissociate the macronutrients of oat bran particles. Electrostatic separation was used to separate particles rich in beta-glucan and starch from those rich in arabinoxylan. The betaglucan from defatted OBC was enriched from 34 to 48% after two steps of electrostatic separation. The 48% beta-glucan fraction was further enriched by a combination of jet-milling and air classification, yielding a fraction with up to 56% betaglucan.

OBC was further processed by partial depolymerisation of beta-glucan with acid- or enzyme-catalysed hydrolysis at relatively low water content using a twin-screw extruder as a bioreactor. The hydrolysed oat brans were extracted with hot water and centrifuged to obtain a water-soluble phase and an insoluble residue. The timedependent gelling of the water-soluble phase was monitored for 14 weeks at 5 °C. Acid hydrolysis depolymerised the beta-glucan molecules from their original average molecular weight (Mw) of 780 to 34kDa (polydispersity 4.0–6.7), and enzymatic hydrolysis down to 49 kDa (polydispersity 19.0–24.2). At 1.4–2.0% beta-glucan concentration, solutions of beta-glucan molecules with Mw>50 kDa agglomerated rapidly, whereas solutions of smaller molecules (34–49 kDa) remained as stable dispersions for longer. Gelling was strongly concentration-dependent; at 1.4 to 1.6% beta-glucan concentration gelling occurred after 7 to 12 weeks of storage, whereas at 1.8 to 1.9% concentration gelling occurred already after 2 weeks.

OBC was used in extruded products in five different forms (untreated, ultra-fine ground, enzymatically hydrolysed and hot-water extracted solubles and insoluble residue). Addition of untreated OBC decreased the expansion (172%) and resulted in harder texture (258 N) compared to extrudates based on 100% endosperm flour (EF) (199% and 148 N, respectively). When OBC was separated into water-insoluble (WISOBC) and water-soluble (WS-OBC) fractions, significant differences were observed in the resulting extrudates. Ten percent addition of WIS-OBC fraction significantly decreased the expansion (163%) and increased the hardness (313 N) of EF-based extrudates, whereas 10 or 20% addition of WS-OBC enhanced the expansion (218–226%) and resulted in less hard textures (131–146 N). The improved texture was most probably due to the high amount of soluble fibres and low protein content.

More information: The complete report is available online: www.vtt.fi/inf/pdf/science/2014/S67.pdf

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