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## Effect of fibers and whole grain content on quality attributes of extruded cereals

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### Abstract

Incorporation of fiber in cereals may lead to quality issues, thus decreasing consumer acceptance. This is partially due to deterioration of the microstructure, one of the primary quality attributes of cereals. The objective of this study was to better understand the mechanisms by which dietary fibers affect the quality of cereal products during extrusion-cooking. The study quantified the effect of amount and type of fiber and whole grain on (i) texture, (ii) structure, and (iii) rehydration properties of extruded cereals. New innovative methods were applied and combined with traditional techniques to characterize both the structure and the rehydration properties. Extruded cereals were produced using a starch-based recipe (whole and wheat flours) and two sources of fibers (oat bran concentrate and wheat bran). The oat and wheat bran levels used in this study were 0, 10, and 20%. The different mixtures were extruded in a pilot twin-screw extruder BC21 (Clextral) and then sugar coated after drying. Mechanical properties of extruded cereals were investigated by compression test. The cellular structure was observed by X-ray tomography. The quality of coating (thickness, homogeneity) was analyzed by optical coherence tomography. The rehydration properties of such cereals in milk were evaluated by magnetic resonance imaging and optical coherence tomography. This work revealed that structure assessment of extruded cereals may lead to a better understanding of the effect of fiber addition on texture and rehydration properties. The application of innovative methods, such as optical coherence tomography and magnetic resonance imaging, was found to be useful to quantify the structural properties.

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*Keywords:* extruded cereal; fibers; structure; texture; rehydration properties; innovative techniques

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## 1. Introduction

Health and nutritional policies are currently promoting the increase of dietary fiber content in food, especially in cereal-based products. However, incorporation of fiber in cereals may lead to quality issues [1-2], thus decreasing consumer acceptance. This is partially due to deterioration of the microstructure, one of the primary quality attributes of extruded cereals [3-5]. Consequently, the production of fiber-enriched extruded cereals remains a challenge, in particular when maintaining functional and quality properties. The objective of this study was to better understand how dietary fibers affect the quality of cereal products during extrusion-cooking. The studies quantified the effect of source and amount of fiber and whole grain on (i) texture, (ii) structure, and (iii) rehydration properties of extruded cereals. New innovative methods were applied and combined with traditional techniques to characterize both the structure and the rehydration properties.

## 2. Materials & Methods

Studies were carried out on starch-based (wheat, whole wheat) recipes. Two sources of fibers were added: oat bran concentrate (OBC) and wheat bran (WB) for their high soluble ( $\beta$ -glucans) and insoluble (arabinoxylans) fiber levels, respectively. The oat and wheat bran levels used in this study were 0, 10, and 20%. The different recipes (Table 1) were extruded in a pilot twin-screw extruder BC21 (Clextral), dried to 3% water (w/w) using a force-air convection oven. The following extrusion parameters were kept constant: die design, screw speed (400 rpm), product temperature (135°C) and water addition (20%).

Table 1. Cereal composition (% dry matter) of different samples

Samples	Whole Grain	Fiber rich ingredients		Filler		
	Whole Wheat	OBC	Wheat Bran	Wheat flour	Corn	Sugar
FO WG40	40	0	0	40	18	2
FO WG60	60	0	0	20	18	2
FO WG80	80	0	0	0	18	2
F10 WG40 OBC	40	10	0	30	18	2
F10 WG60 OBC	60	10	0	10	18	2
F10 WG80 OBC	80	10	0	0	8	2
F10 WG40 WB	40	0	10	30	18	2
F10 WG60 WB	60	0	10	10	18	2
F10 WG80 WB	80	0	10	0	8	2
F20 WG40 OBC	40	20	0	20	18	2
F20 WG60 OBC	60	20	0	0	18	2
F18 WG80 OBC	80	18	0	0	0	2
F20 WG40 WB	40	0	20	20	18	2
F20 WG60 WB	60	0	20	0	18	2
F18 WG80 WB	80	0	18	0	0	2

Each sample was coated with 30% (w/w) of syrup composed of sucrose (67%), dextrose (5%) and water (28%) and dried again to 3% water (w/w).

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