

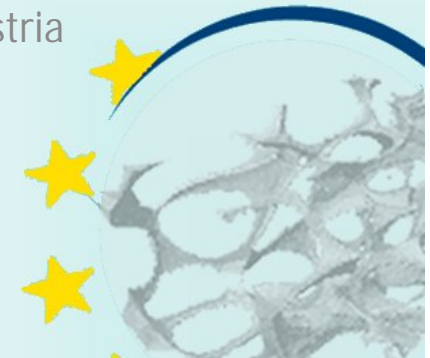
Effect of fibers and whole grain content on quality attributes of extruded cereals

Sophie Chassagne-Berces¹, Michael Leitner², Angela Melado³, Pilar Barreiro³,
Eva Crostina Correa³, Imre Blank¹, Jean-Claude Gummy¹, H el ene Chanvrier¹

¹NESTEC SA, Nestle PTC Orbe, Orbe, Switzerland

²RECENDT- Research Center for Non Destructive Testing, Linz, Austria

³UPM, Madrid, Spain



Introduction



- Increasing the nutritional benefit of cereals

↗ whole grain
↗ fiber rich ingredients
↘ sugar
↘ salt

Sources of carbohydrates,
fiber, vitamins and antioxidants
Essential for a healthy diet

- Consequences of whole grain and fiber rich ingredients addition

– Sensory Quality degradation



➔ Key components for consumer perception
• complex and multidimensional

Our approach: combining instrumental techniques to study the effect of fibers on quality attributes

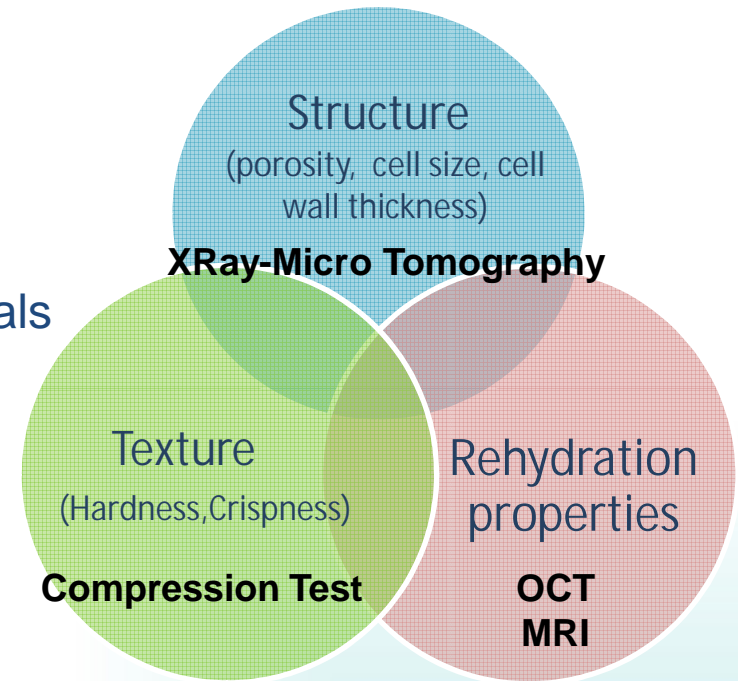
Recipe parameters

- Starch-based recipe :
 - ✓ whole wheat flour = Whole grain
 - ✓ wheat flour
- Addition of fiber rich ingredients:
 - ✓ oat bran
 - ✓ wheat bran

Extrusion parameters Constant

- a pilot twin-screw extruder **BC21** (Clextral) with fixed parameters
 - ✓ die design
 - ✓ screw speed (400 rpm)
 - ✓ product temperature (135°C)
 - ✓ water addition (20%)
- dried in oven to 3% water (w/w)
- coated

Extruded cereals products



Objective: better understand how dietary fibers affect the sensory quality of cereal products during the extrusion-cooking

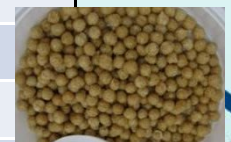
Outline

- ➔ I. Experimental details
- II. Results
 - 1. Mechanical properties
 - 2. Structure
 - 3. Rehydration properties
- III. Conclusion



15 products with systematic variation of the key ingredients

Samples	Whole Grain	Fiber rich ingredients		Filler		
	Whole wheat (% dry matter)	Oat Bran Concentrate (% dry matter)	Wheat Bran (% dry matter)	Wheat Flour (% dry matter)	Corn (% dry matter)	Sugar (% dry matter)
F0 WG40	40	0	0	40	18	2
F0 WG60	60	0	0	20	18	2
F0 WG80	80	0	0	0	18	2
F10 WG40 OBC	40	10	0	30	18	2
F10 WG 60 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 WG 60 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



All extruded cereals were coated with slurry composed of sucrose (67%), dextrose (5%) and water (28%)

- Coating : 30 % / - Base of recipe : 70 %

Characterization of mechanical properties, structure and rehydration properties



XRay-Micro Tomography (Skyscan 1172, Belgium)

- Porosity
- Cell size
- Cell wall thickness
- Specific surface (= complexity of structure)

Structure

Texture

Rehydration properties

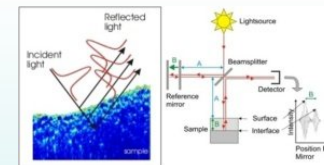
Kramer shear test

dry / after 1 min in ambient milk
3 / 5 repetitions per products

- Hardness (F_{max})
- “Crispness” (Number of peak)



OCT

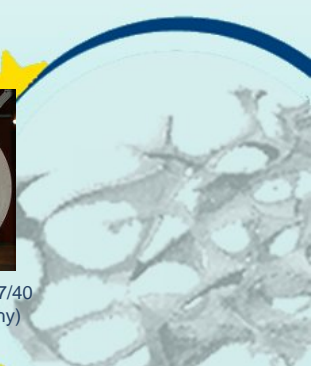


Filled with milk (20°C) to 80% of the height of cereal pellets

MRI



Bruker BIOSPEC 47/40
(Ettlingen, Germany)

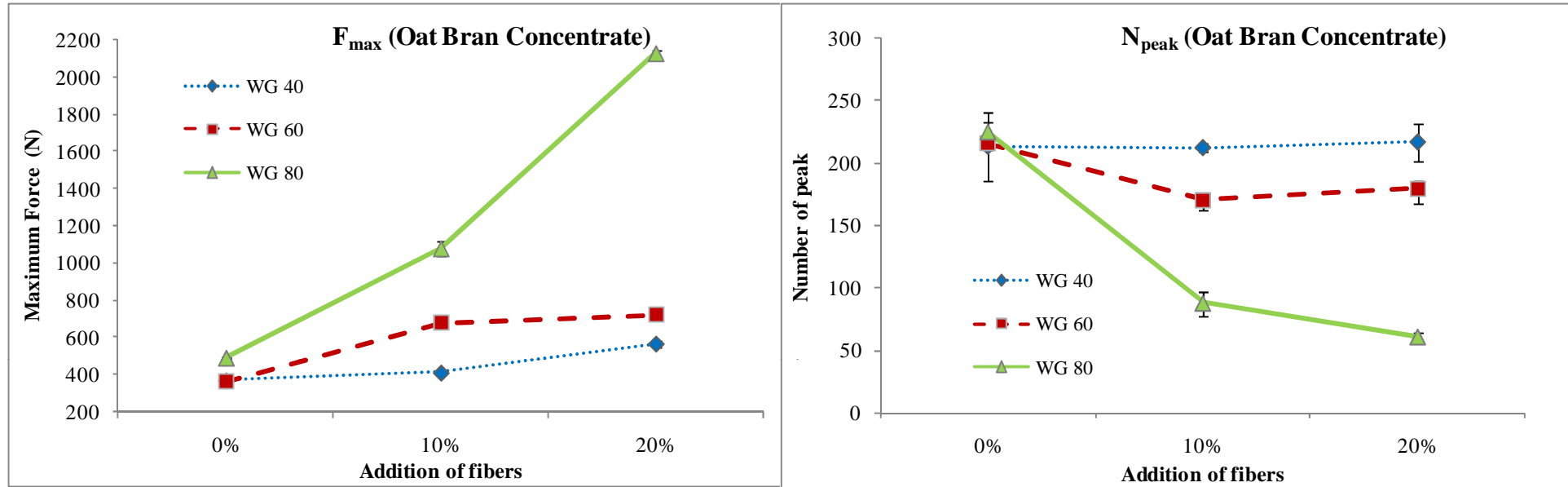


Outline

- Experimental details
- ➔ • Results
 - Mechanical properties
 - Structure
 - Rehydration properties
- Conclusion



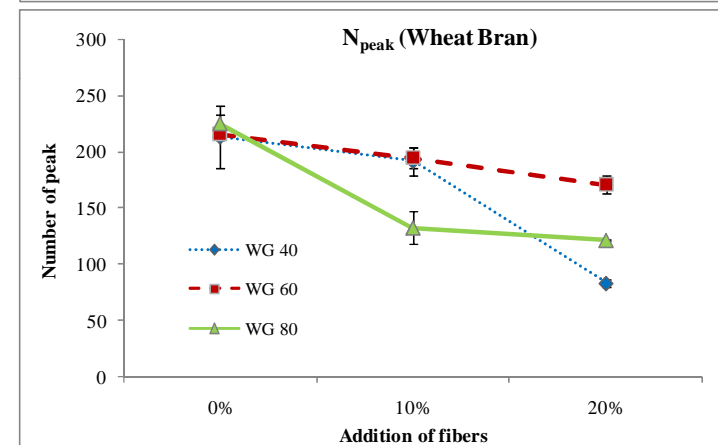
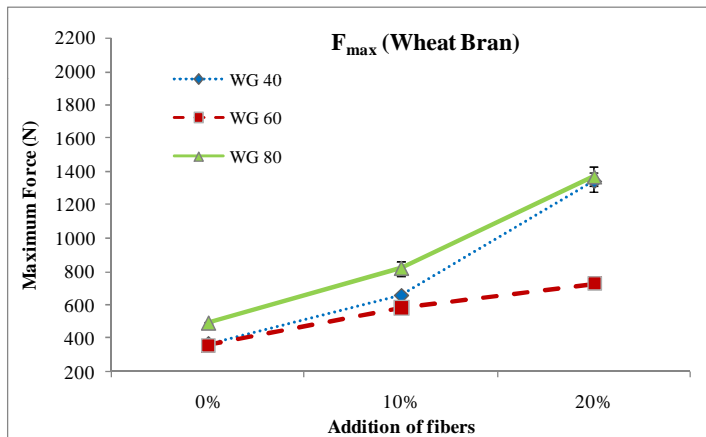
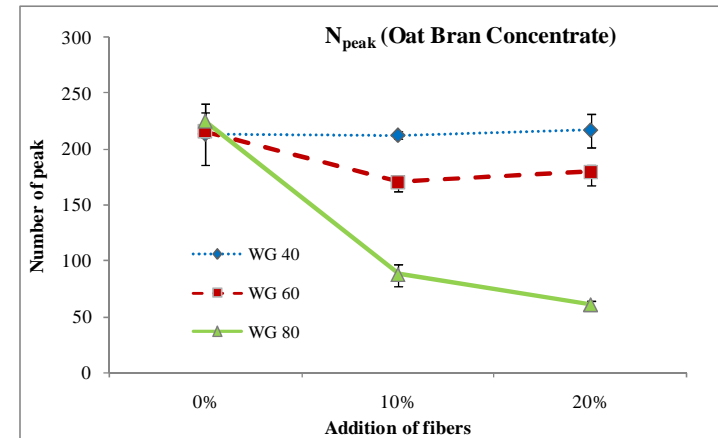
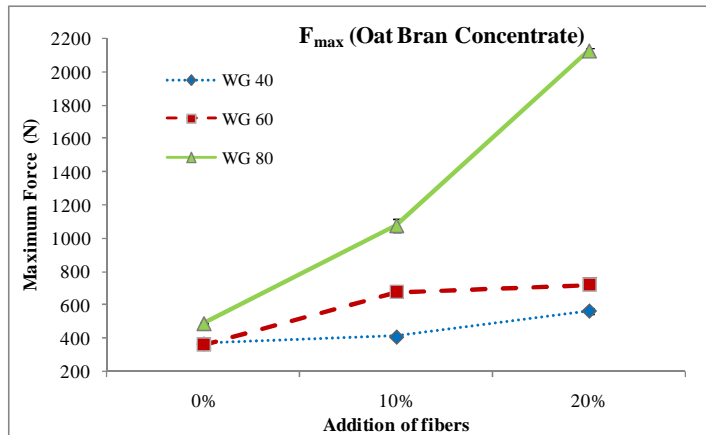
The addition of fibers rich ingredients influence Mechanical Texture (Kramer shear cell, Nestlé)



- Without addition of fibers (0%), F_{max} and N_{peak} do not change much when increasing the whole grain content
- Adding fibers significantly increases F_{max} , and decreases N_{peak}
- The higher the addition of fibers, the more the addition of whole grain has an impact on texture properties (F_{max})

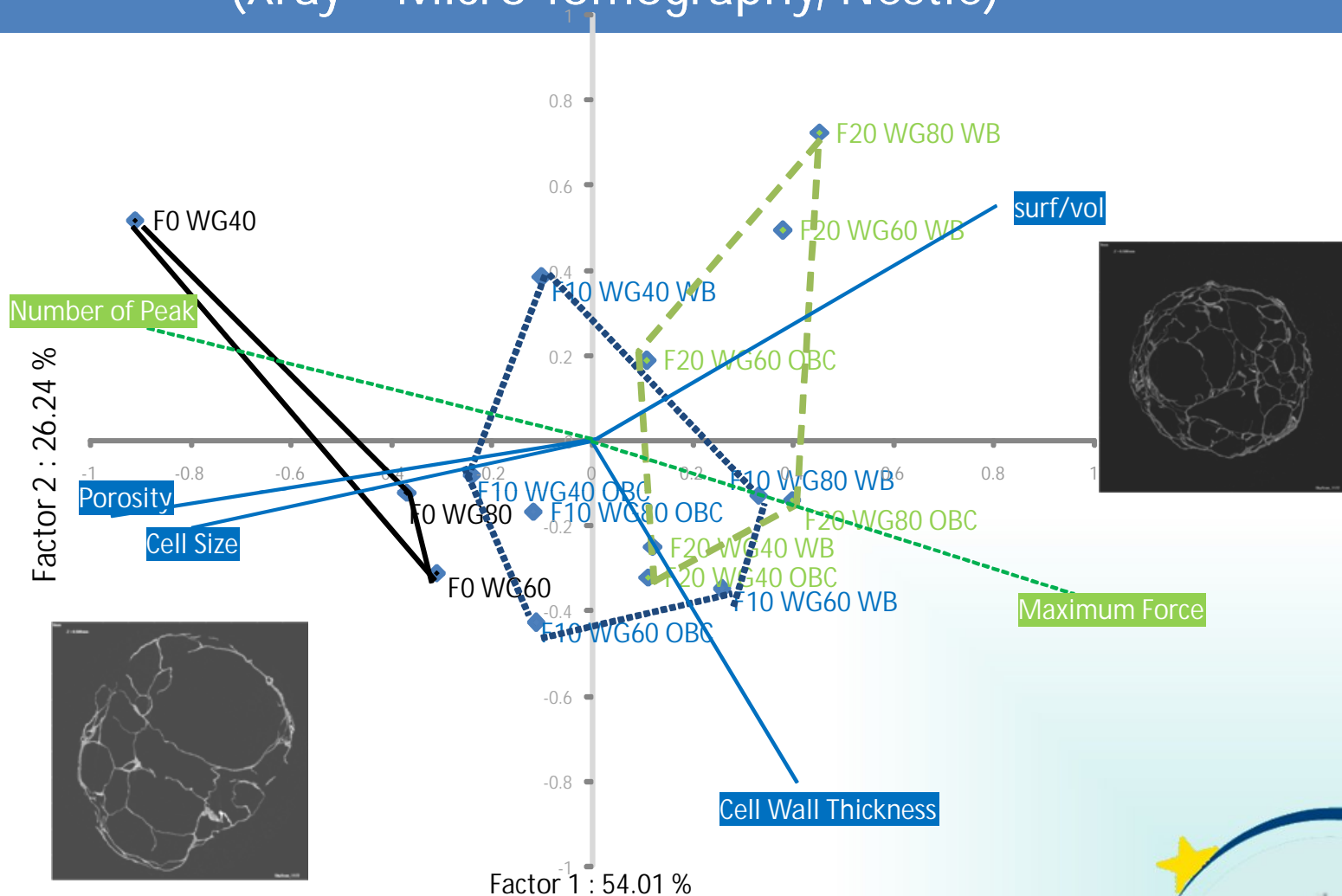


The addition of fibers rich ingredients influence Mechanical Texture (Kramer shear cell, Nestlé)



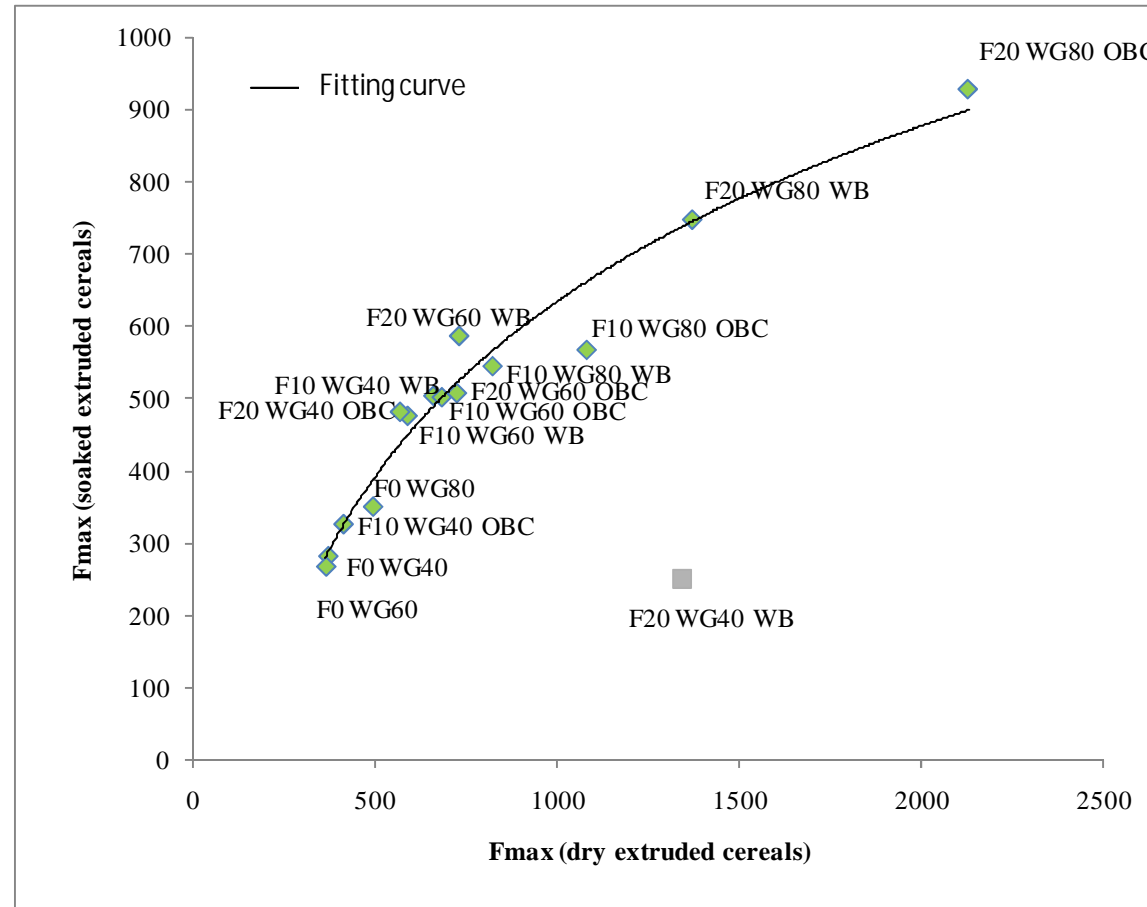
- Modifications of mechanical properties after addition of wheat bran show similar trends than with Oat Bran Concentrate
- The modifications of texture parameters seem to be more important with oat bran concentrate than with wheat bran

The addition of fibers rich ingredients influence the structure (Xray – Micro Tomography, Nestlé)



- Without addition of fibers (F0), only minor modifications of porosity and cell size are observed when the whole grain content increases
- Adding fibers decreases the expansion of extruded cereals and thus the cell size and the porosity decrease

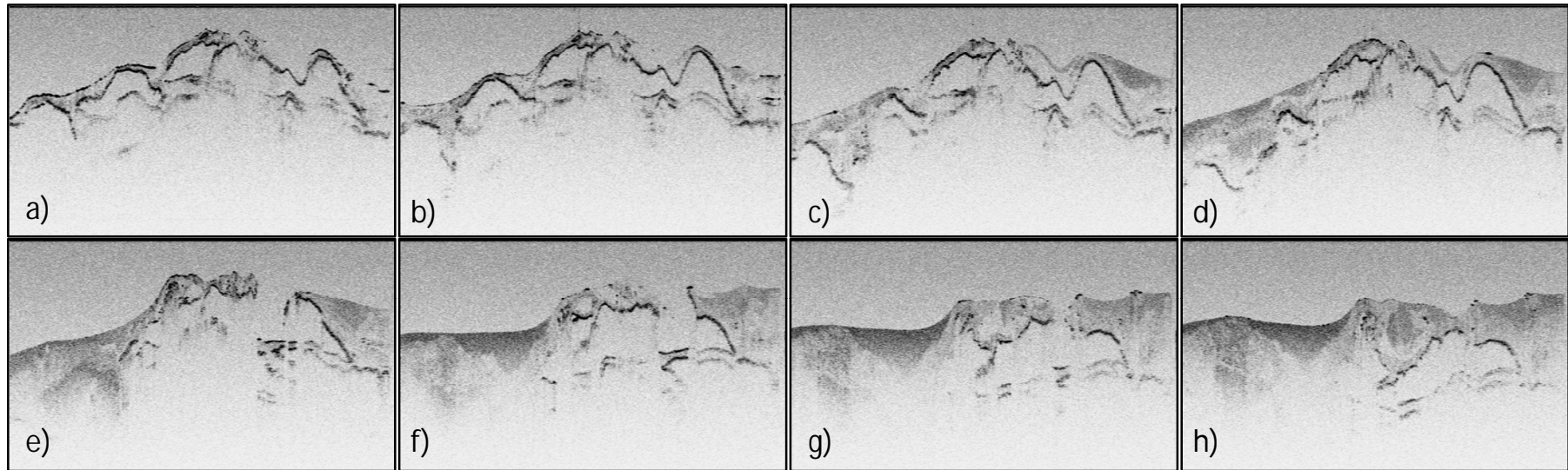
Correlations between the hardness measured for dry and soaked extruded cereals



- A loss of hardness and crispness after immersion in milk
- With low amount of fibers ($\leq F10$, $\leq WG 60$) : "keeping hardness" after immersion in milk



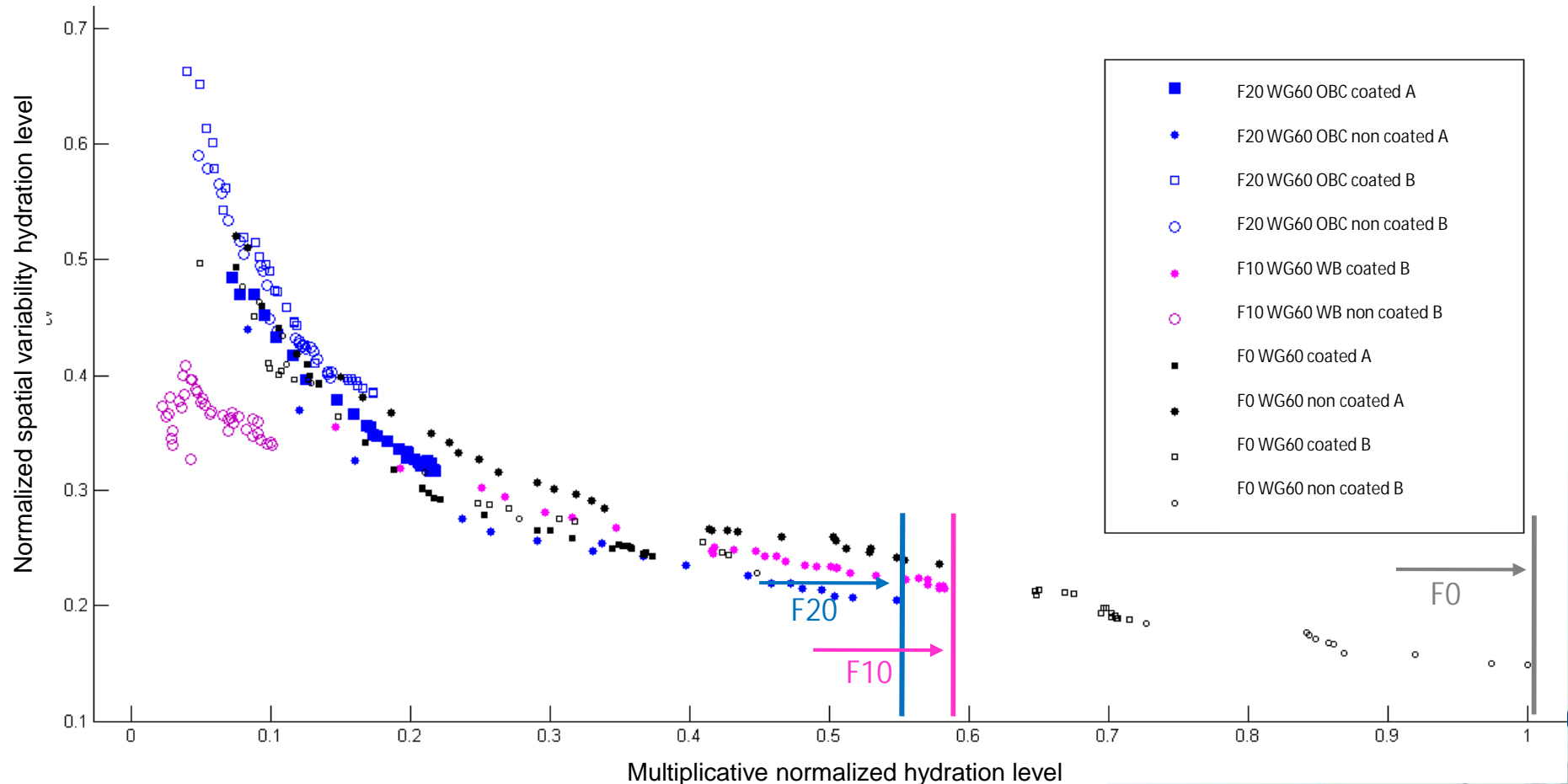
The addition of fibers rich ingredients influence the rehydration properties (OCT by RECENDT, Austria)



- OCT made it possible
 - ✓ to visualize the quality of coating (for dry pellets)
 - ✓ to follow the rehydration process



The addition of fibers rich ingredients influence the rehydration properties (MRI by UPM, Spain)



- The higher the addition of fiber is, the shorter the trajectory is, corresponding to a lower hydration.

Outline

- Experimental details
- Results
 - Mechanical properties
 - Structure
 - Rehydration properties
- ➔ • Conclusion



Conclusion

	Texture	Structure	Rehydration properties
Increasing the fiber addition...	<ul style="list-style-type: none"> ↗ Hardness ↘ Crispness 	<ul style="list-style-type: none"> ↘ Porosity ↘ Cell size 	<ul style="list-style-type: none"> ↘
Increasing the whole grain addition...			
<ul style="list-style-type: none"> • without addition of fiber (F0) 	~ Hardness	<ul style="list-style-type: none"> ~ Porosity ~ Cell size 	Prospects
<ul style="list-style-type: none"> • the higher the fiber addition is... 	<ul style="list-style-type: none"> ↗ ↗ Hardness ↘ ↘ Crispness 	<ul style="list-style-type: none"> ↘ ↘ Porosity ↘ ↘ Cell size 	



Interest of combining instrumental techniques to better understand the effect of fiber addition on quality attributes of extruded cereals

