

Selection and Evaluation of Rice Flours for Gluten-Free Cookies



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Context and objectives

Gluten-free market



Year	2010	2015	2017	2020
Market (billion \$)	3.5	5 (+43%/2010)	6.6 (+32%/2011)	7.59

- +10%/year until 2025
- 3 groups of people: coeliac + gluten sensitive + healthy lifestyle

Context

- Replacing gluten-containing cereals like wheat: various raw materials available
- Rice advantages: neutral flavor, whiteness, easy to digest, low in sodium, hypoallergenic properties
- Rice flours available on the market are very diverse
 - A direct impact on the quality of the finished products
 - Challenges to develop and validate gluten-free products
- No standards tests available for gluten-free products



Objectives



- Evaluate the impact of rice flour origin on cookies quality
- Determine the rheological properties of different rice flours using Mixolab
- Identify correlations between the properties of finished products and Mixolab rheological behavior.

Cookie baking tests

6 commercial rice flours

Sample	Rice 1	Rice 2	Rice 3	Rice 4	Rice 5	Rice 6
H2O (%)	11.97	12.14	11.95	12.10	10.41	13.14
Pictures						
						
Comments	Glutinous rice flour (high in amylopectin)	Rice flour	High fiber rice flour	Whole grain rice flour	Rice flour	Rice flour

Cookie baking tests

Reference protocol from LEMPA, Laboratoire National de la Boulangerie Pâtisserie[®], Rouen.

	Cookie recipe		
Mixing phase 1	Butter	16,4%	159,3 g
	Sugar	16,4%	159,3 g
	Salt	0,3%	3,2 g
Mixing phase 2	Egg	15,4%	150 g
Mixing phase 3	Flour	51,4%	500 g
	Yeast	0,2%	1,8 g
Total weight		100%	973, 5 g

Cookie baking tests

Reference protocol from LEMPA, Laboratoire National de la Boulangerie Pâtisserie[®], Rouen.

- Mixing
 - Phase 1: 4 minutes at speed 6
 - Phase 2: 4 minutes at speed 5
 - Phase 3: 3 minutes at speed 1
- Relaxation: 1 hour at 4°C
- Lamination
- Cutting: 60 mm pieces
- Blocking: 1 hour at 4°C
- Baking:
 - On perforated plate using ventilated oven
 - Preheating at 220°C, 9 minutes at 170°C



Mixer: Alphamix

Cookie baking tests

Reference protocol from LEMPA, Laboratoire National de la Boulangerie Pâtisserie[®], Rouen.

- Laminated dough, sugar crust pastry, at constant hydration



Sugar crust pastry dough



Cookie pieces

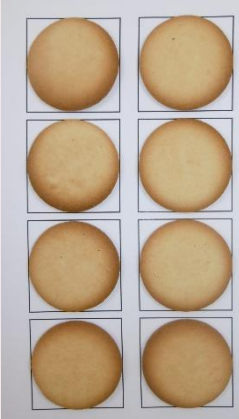
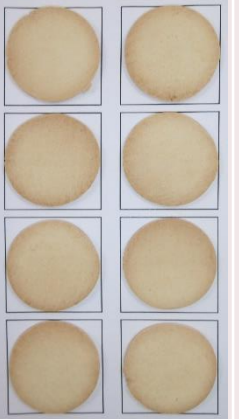
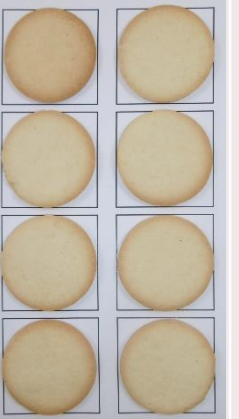
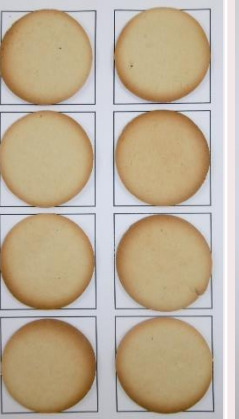
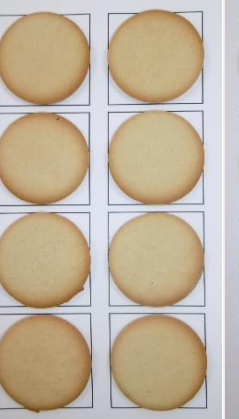
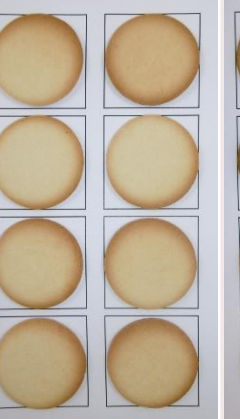
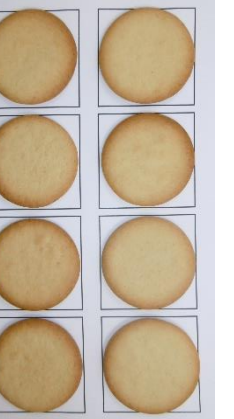


Cookie texture

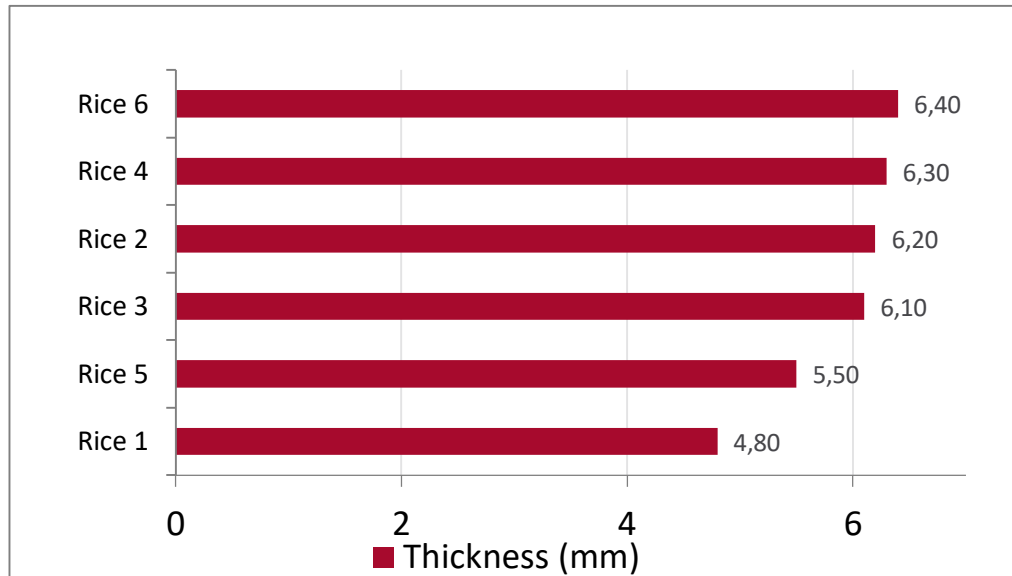


- Finished products: physical properties (**thickness, weight**) and sensory tests (**texture and taste**)

Cookie baking tests

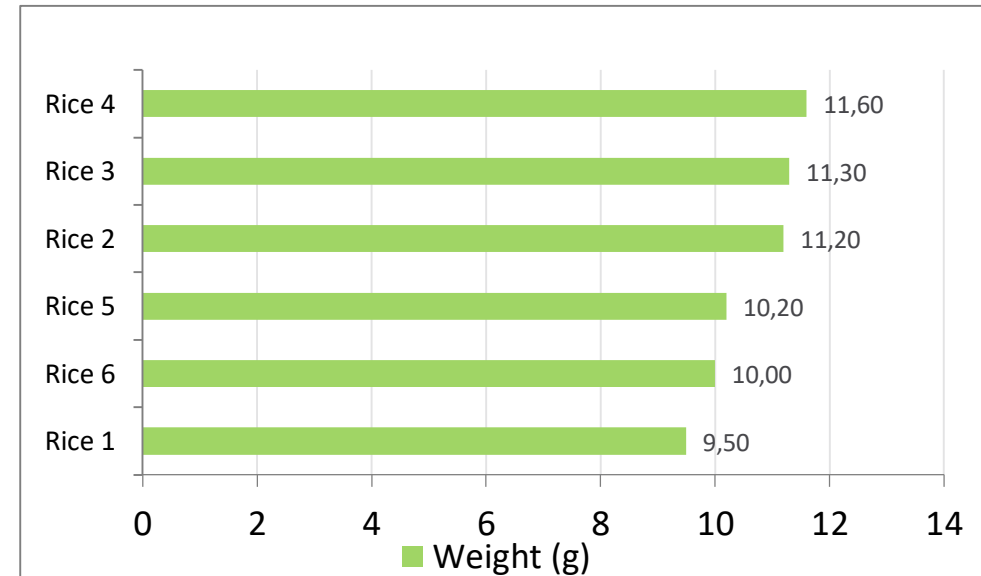
Sample	Rice 6	Rice 1	Rice 2	Rice 3	Rice 4	Rice 5	Wheat							
Total score (maximum 300)	245	255	285	280	280	290	280							
Pictures														
Comments	lowest total score, darkest color		lightest color (same supplier)		medium color, high total score			comparable results (color, texture and total score) with wheat formulation		<i>medium color, high total score</i>				

Cookie physical properties



Wheat: 6.20 mm

- Rice 1 cookies : thinnest
- Rice 2, 3 and 4 cookies : high thickness values
- Rice 5 cookies : thin
- Rice 6 cookies : thickest



Wheat: 9.8 g

- Rice 1 cookies : lowest weight
- Rice 2, 3 and 4 cookies : high weight values
- Rice 5 cookies : medium weight
- Rice 6 cookies : medium weight

Cookie baking tests - short recap

- Sensory tests (taste + texture) :
→ 3, 4 and 5 = best candidates
- Physical properties (weight and thickness) :
→ 2, 3 and 4 = OK candidates, but higher weights compared to wheat cookies
- **Combining sensory + physical results :**
→ **3 and 4 = best formulations**



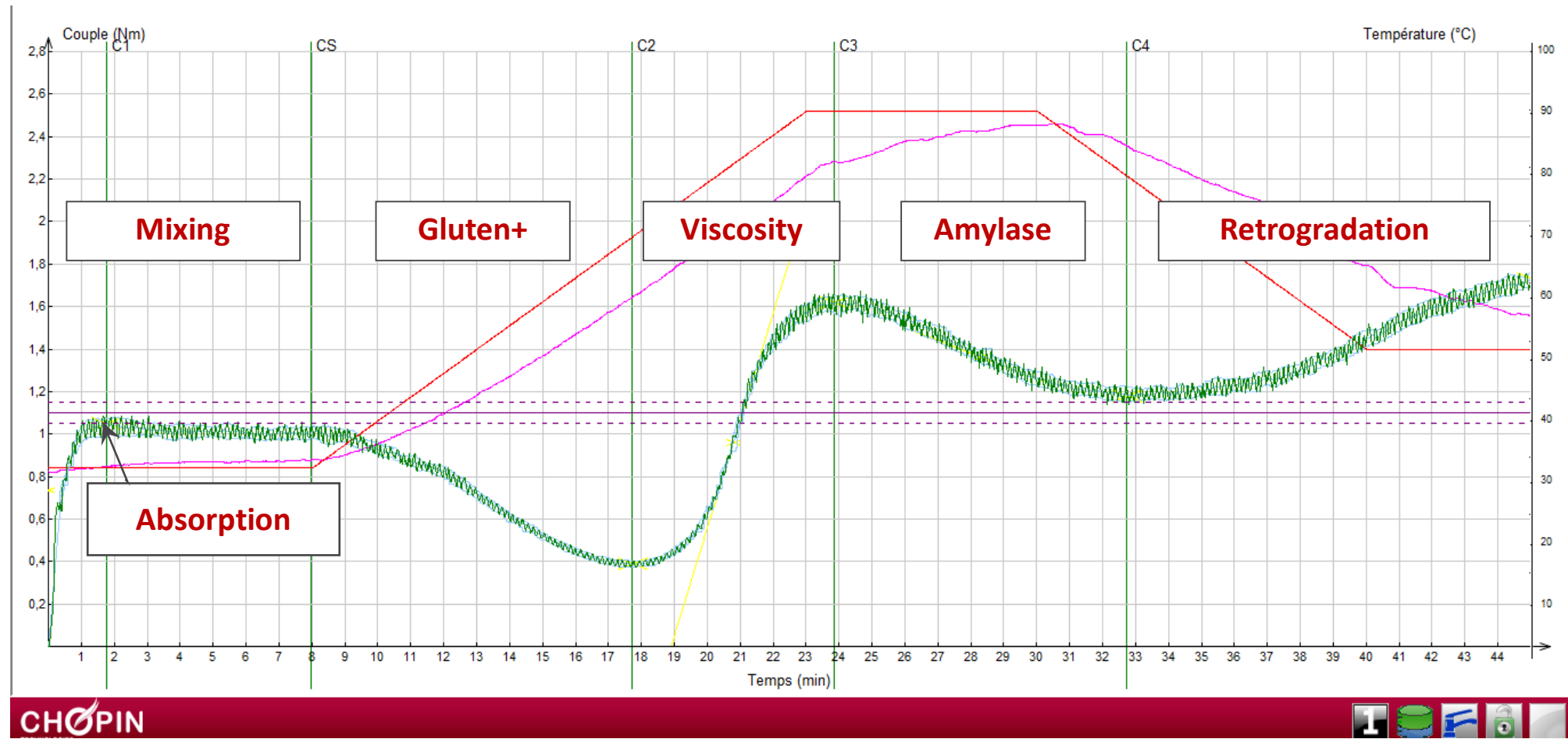
Rheological analyses

Mixolab2 – what does it do?



- Recording mixer, with the ability to apply a heating and cooling cycle on a 75-100g dough sample
- Evaluates 6 dough quality criteria:
 - Water absorption
 - Effects of mixing (development and stability)
 - Gluten (protein) strength
 - Maximum viscosity
 - Amylase activity
 - Starch retrogradation

Mixolab2 - Standard results

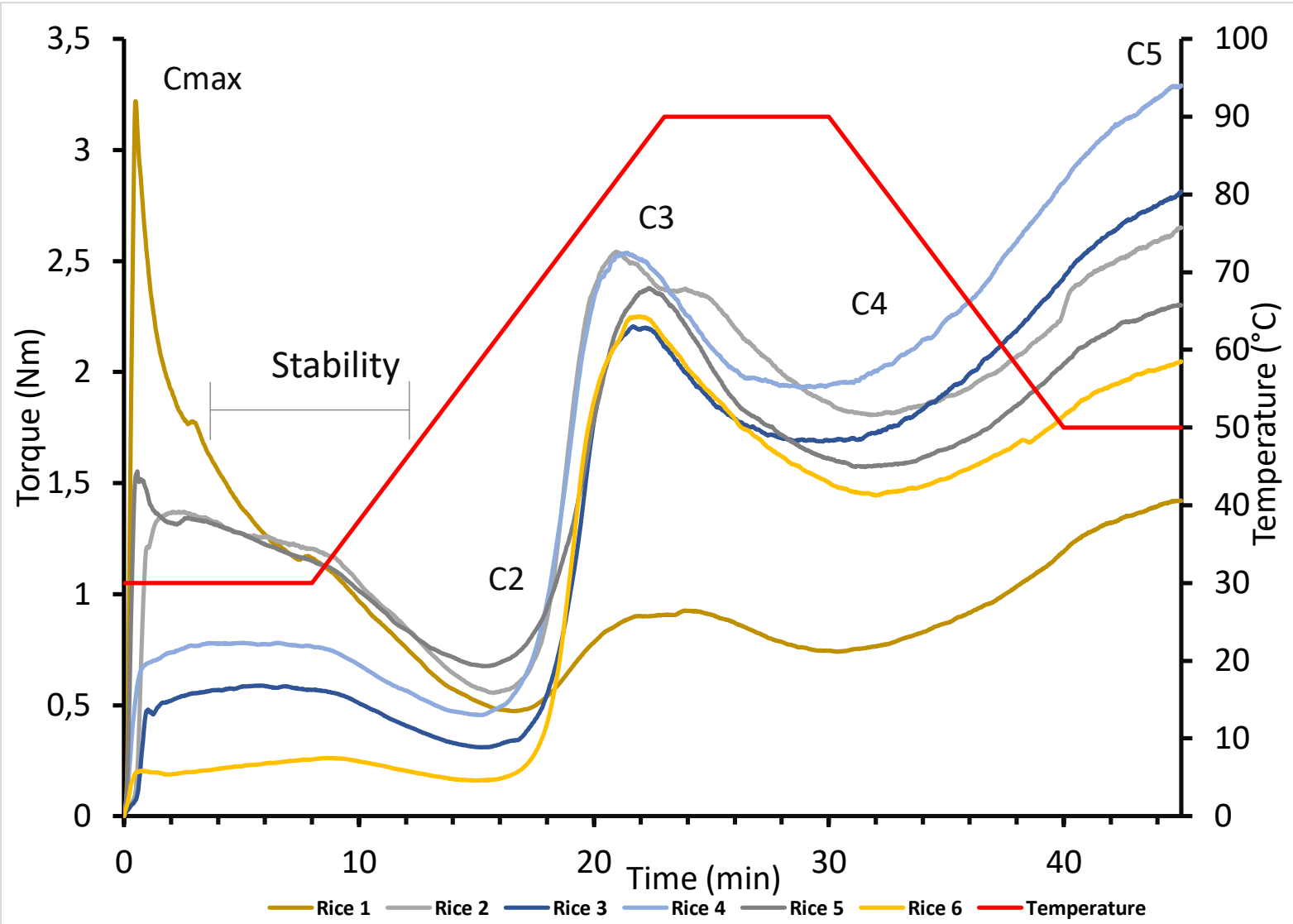


A specific protocol was developed

- Specific protocol for gluten-free dough
- 90g of dough
- 70% (b14) hydration
- Mixing at 150rpm

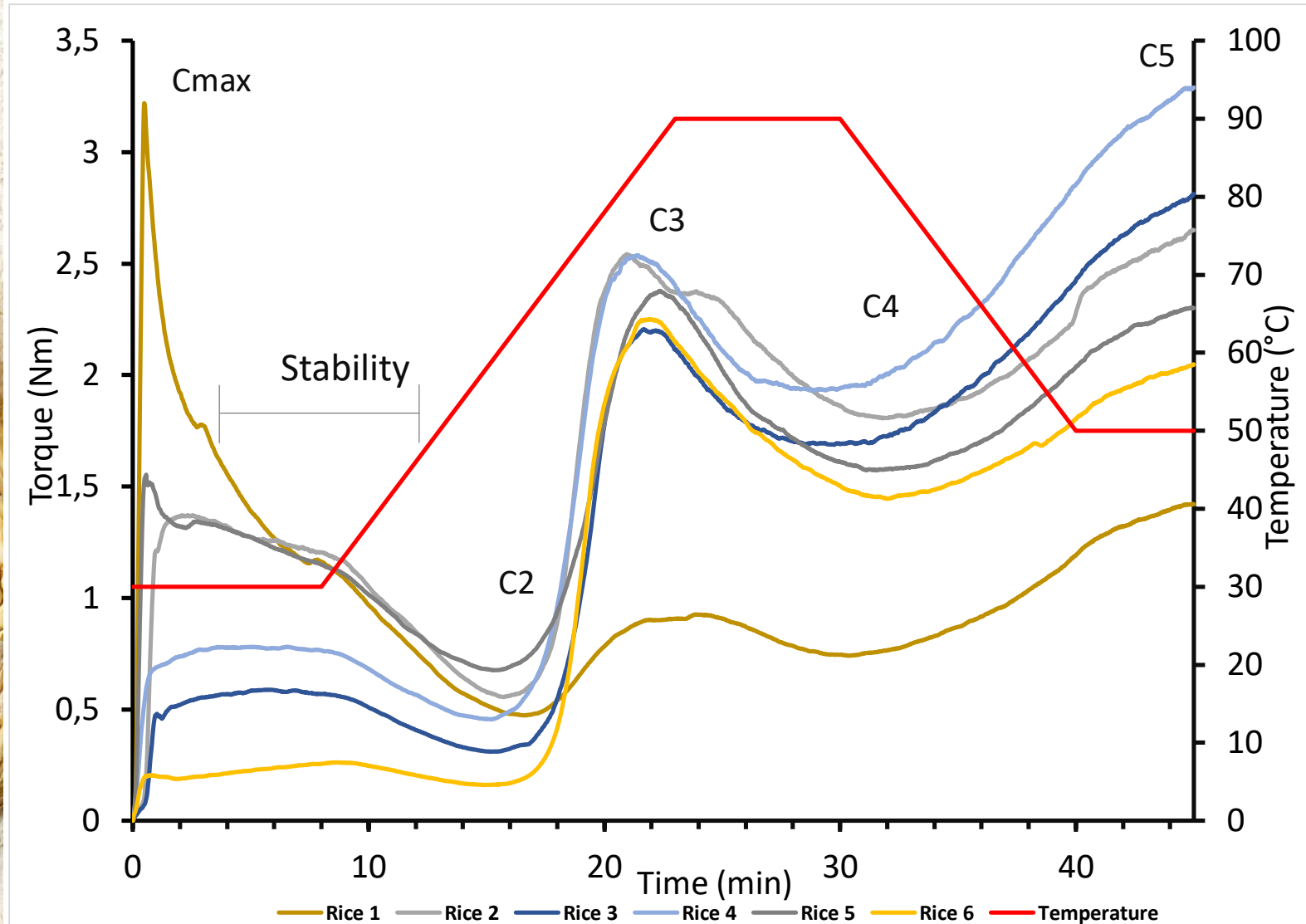
Rice protocol	
Dough weight	90 g
Hydration	70% (b14)
Mixing speed	150 rpm
Water tank temperature	30 °C
Temperature 1 st step	30 °C
Duration 1 st step	8 min
Temperature 2 nd step	90 °C
1 st temperature gradient	4 °C/min
Duration 2 nd step	7 min
2 nd temperature gradient	- 4 °C /min
Temperature 3 rd step	50 °C
Duration 3 rd step	5 min
Total analysis time	45 min

Mixolab rheological properties



- Various rice flours => various Mixolab profiles, able to make different groups
- Rice 1: high cold consistency, lowest consistency during heating (glutinous rice flour)
- Rice 2 and 5: relatively close consistency whatever the mix stage
- Rice 3 and 4: relatively close consistency whatever the mix stage (high fiber content flours)
- Rice 6: lowest cold consistency and relatively high consistency during heating (flour with higher particle size)

Mixolab rheological properties



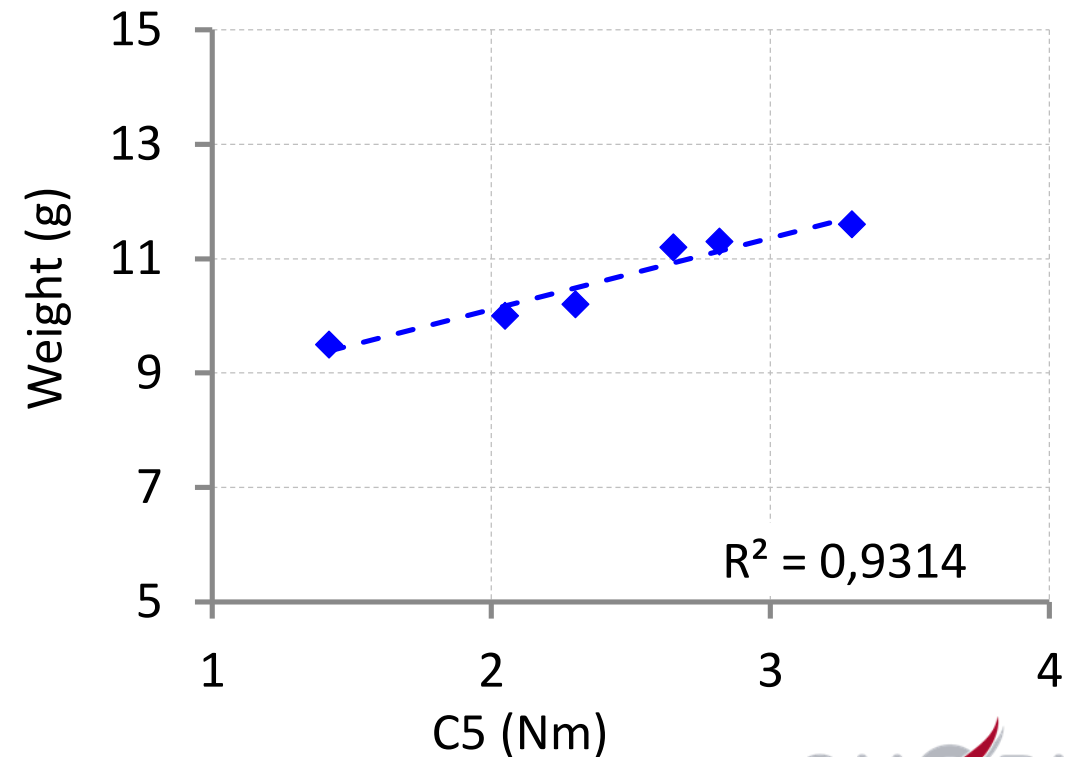
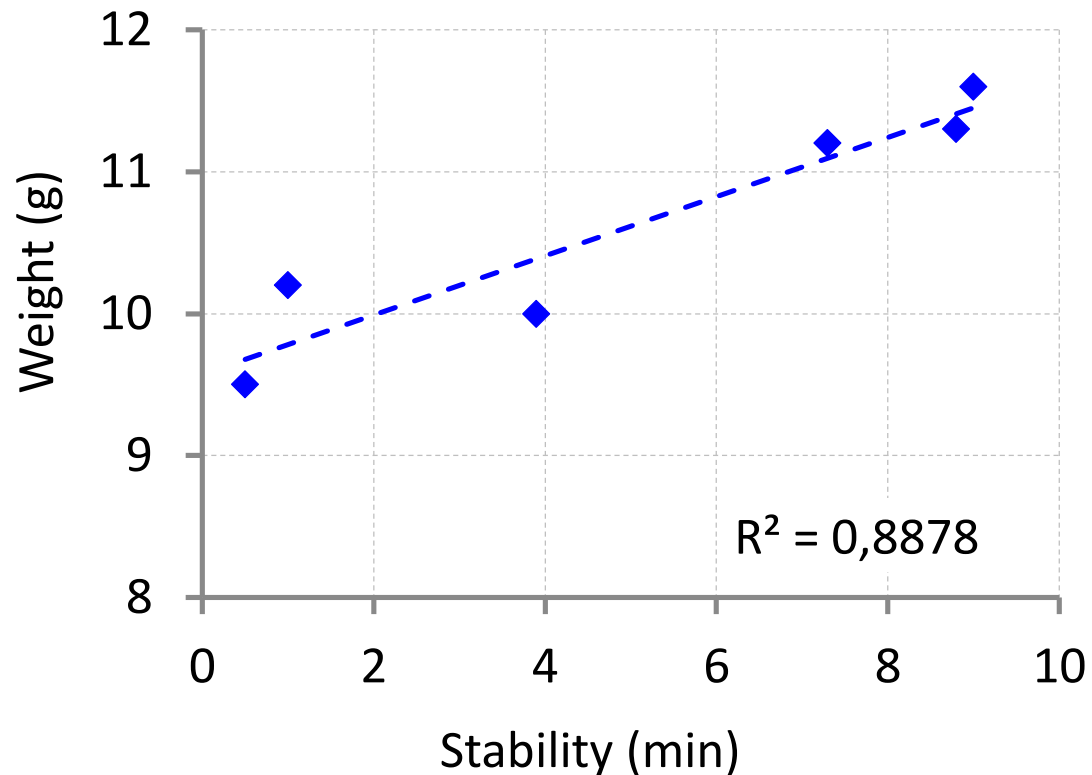
- **Rice 1 and 6 :**
 - Lowest total score (texture + taste)
 - “Extreme” rheological behaviors
 - => ELIMINATE these formulations
- **Rice 3 and 4 :**
 - Best candidates (sensory + physical properties)
 - Similar rheological behavior
 - => TARGET TO REACH
- **Based on rheological 45mn tests :**
 - Eliminate inadequate formulations
 - Set target
 - Focus on formulations close to target

Correlations

Between rheological data and
cookies baking tests results

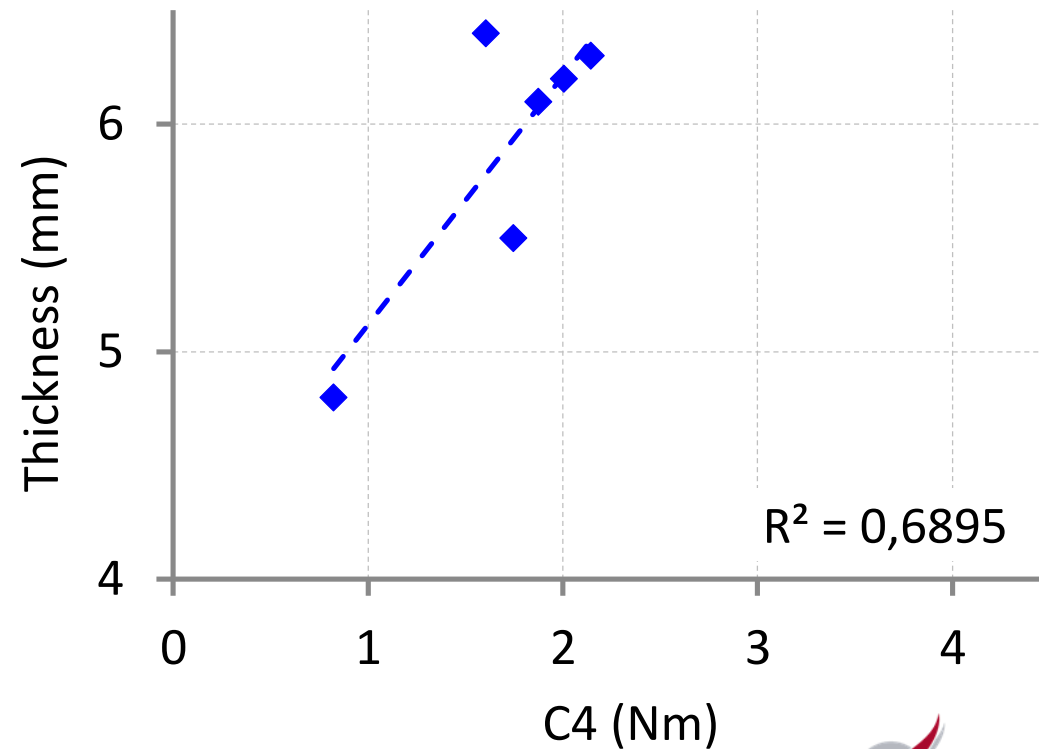
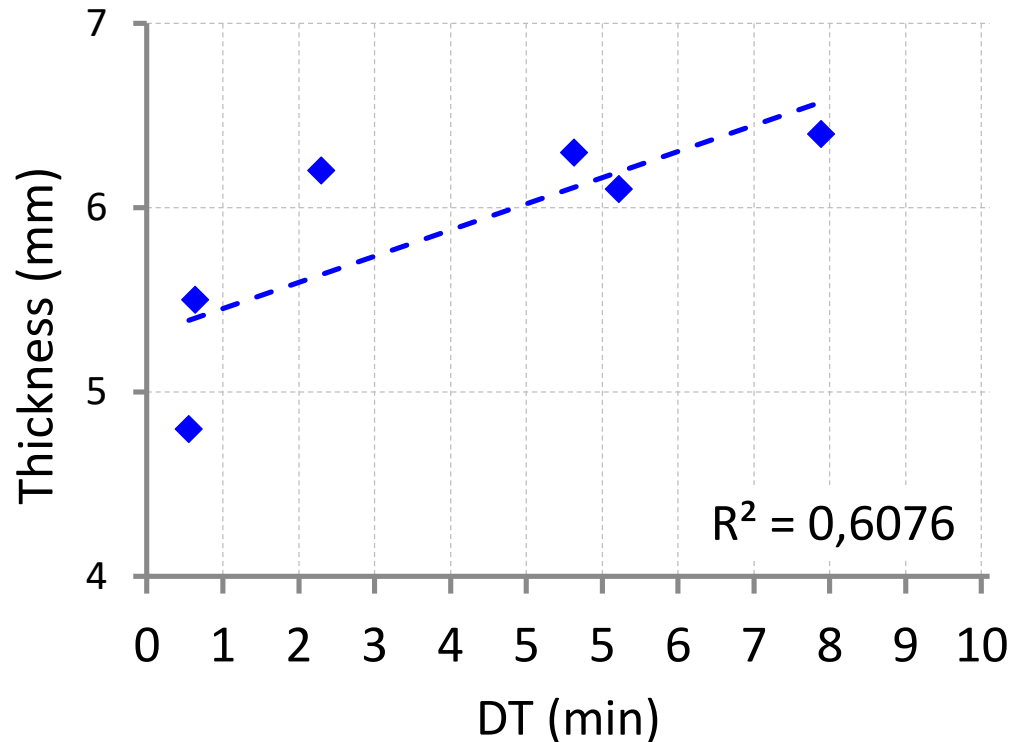
Technological tests vs rheological tests

- **Cookie weight** is highly correlated with Stability and Mixolab C5 (starch retrogradation)



Technological tests vs rheological tests

- **Cookie thickness** is highly correlated with Mixolab C4 (hot gel stability) and Dough development time



What we learnt...



- Cookies made from rice flour showed differences in **color** and **physical properties** depending on the origin of flours
- Different rice flours have very different rheological properties (as measured by Mixolab)
- Characteristics of the **finished products** were highly correlated with **Mixolab rheological data**
- It is possible to use rheological testing to:
 - **Screen** raw materials, **eliminate** the ones inadequate and **keep** only the promising ones
 - **Predict** final products properties of gluten-free cookies
- Benefits of using rheological testing:
 - Work hand-in-hand with baking tests
 - Speed up NPD process
 - Choose raw materials and ensure their regularity

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Questions?



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