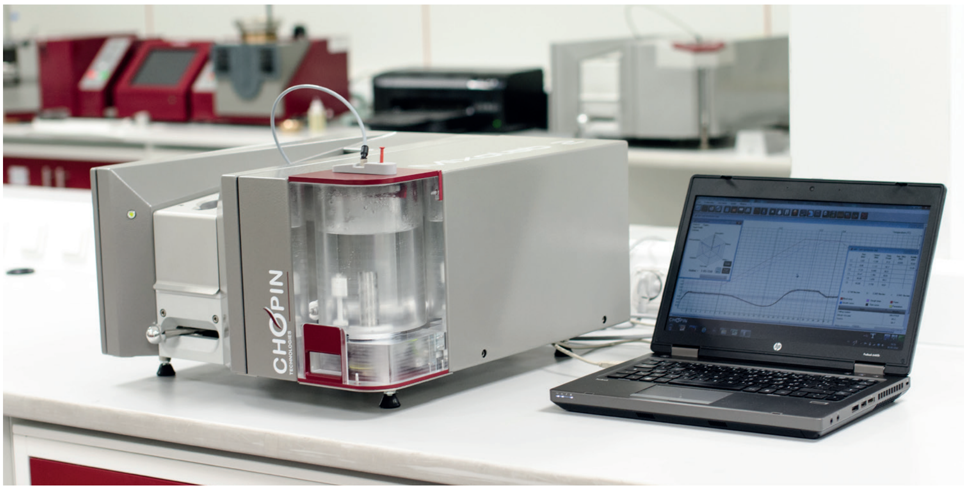
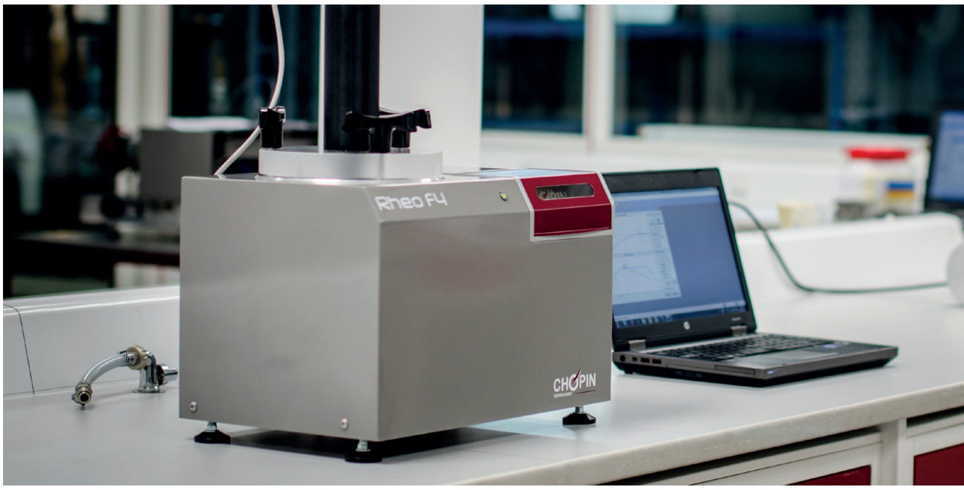
GLUTEN FREE

Analytical solutions for the development of high-quality gluten-free products



Master mixing and baking behavior

- The CHOPIN MIXOLAB 2 has the capability of measuring the rheological behavior of a complete gluten-free dough during mixing and baking, which allows for the selection of the best raw materials and ingredients.



Optimize proofing performance

- The CHOPIN RHEO F4 helps with the optimization of the proofing conditions, the selection of the correct mixer settings to optimize proofing, and to ensure that the desired volume and crumb structure is obtained.

- **Create new Gluten-free product**
- **Select the raw materials and all ingredients**
- **Monitor the dough behavior during mixing baking and proofing**
- **Anticipate the final product quality**

TECHNOLOGIES

Celiac-suffering patients deserve the best gluten-free products. CHOPIN Technologies' solutions provides the tools to help better understand and master the specific rheology of gluten-free dough.

Importance of the Gluten-free products

About 2% of the global population suffers from Celiac disease. This intolerance to a specific part of the gluten (the gliadins) causes an inflammation of the villi of the small intestine. This gluten intolerance is extremely restrictive and once diagnosed, the only treatment is to apply a life-long strict diet, avoiding any presence of gluten in food.

There is a need to develop different types of products (bread, pizza, biscuits, pastries, pastas, etc.) without using gluten-containing cereal such as wheat, barley, rye, triticale, spelt or kamut. The development of gluten-free products allows celiac patients to enjoy diverse eating experiences while keeping them away from gluten containing food.

Producing gluten-free products involves re-inventing most of the conventional formulas and processes based on the unique ability of gluten to create a protein network, giving the dough its rheological behavior and leading to the structure and shelf life of the final product.

Technical aspects of gluten-free production

The use of «new» raw materials

Rice, corn, buckwheat, quinoa and other non-gluten containing flours are the base of the formulae.

The use of hydrocolloids

Different gums (carragenan, CMC, HPMC...) and some external protein sources (soybean, egg...) are used to replace the gluten functionalities.

The necessity to work on very hydrated dough

Optimum water levels are critical for the quality of gluten-free products. In most cases gluten-free dough is more hydrated than conventional dough, leading to a complete change in its rheology. The baking phase is particularly critical and must be well mastered.

The flavor, the texture and the shelf life

All gluten-free products aim to reach the standards corresponding to the quality of the conventional gluten-containing product.

Technical aspects of gluten-free production

Every professional aiming to produce an attractive gluten-free product (bread, pizzas, etc.) requires a deep knowledge of the parameters affecting the quality of the end-product. As for conventional cereal products, the final results depends on the mastering of the formula and the process. For a gluten-free product, this relationship between formula and process is much more complex, which leads producers to:

- Know the rheological properties of non-gluten cereal and other raw material.
- Replace the unique capability of gluten to develop a protein network.
- Select the most efficient ingredients and additives (hydrocolloids...).
- Set the correct water level and work with highly hydrated dough.
- Keep the gas bubbles evenly distributed in a low-viscosity dough.
- Avoid coalescence and disproportnation of bubbles during baking.
- Understand starch behavior during baking.
- Improve flavor by using sourdough.
- Maintain or enhance nutritional values.
- Master the dough behavior mainly based on starch properties.
- Find the best formula available that allows products to have a long shelf life.
- Adapt the formula depending on the quality of the raw material at hand.

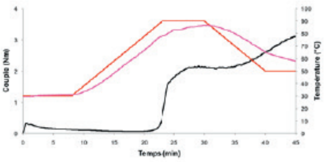
The MIXOLAB 2 and the RHEO F4 are two analytical tools specifically adapted to help R&D and QC teams create the right formula to ensure the production consistency day after day.

CHOPIN TECHNOLOGIES

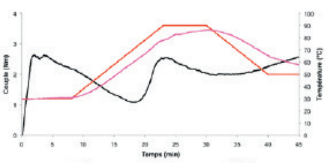
The CHOPIN MIXOLAB 2 measures dough behavior during mixing, heating and cooling allowing gluten-free producers to optimize the formulation and anticipate the final product quality.

Selection of the raw material

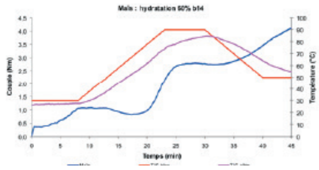
Millet



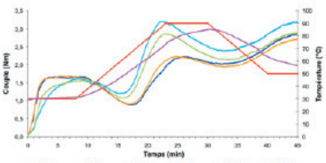
Teff



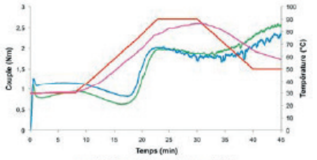
Corn



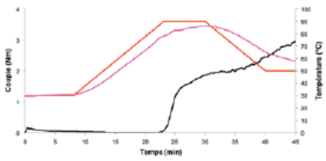
Rice



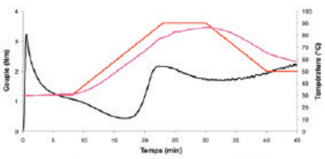
Buckwheat



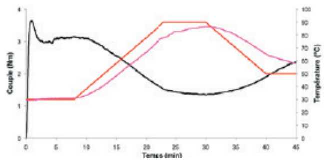
Fonio



Quinoa



Amaranth

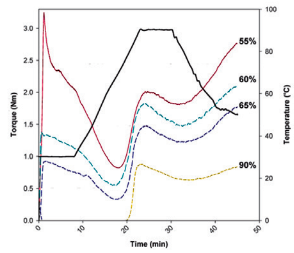


All raw materials perform differently. It is important to completely screen their behavior during mixing, heating and cooling.

Adjustment of the correct water level for mixing and baking

Dough hydration is critical when developing gluten-free baked goods. This example shows that completely different dough consistency profiles were obtained when variable amounts of water were added to rice flour.

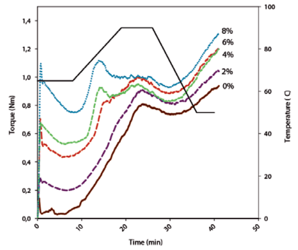
Addition of water greatly impacts the protein-mixing behavior but is also noticeable during the heating/cooling process by impacting on starch gelatinization, gel stability and the setback.



Development of new formulae

It has been observed that HPMC (hydroxypropylmethylcellulose) behaves as a good gluten substitute in a rice bread formula, due to its gas-retention capability and as a crumb-structuring agent. Upon addition of HPMC, the consistency and rheological properties of rice dough closely resembles that of wheat dough.

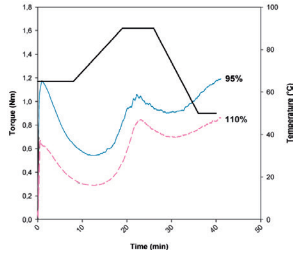
The graph on the right shows that the level of hydrocolloid added (2%, 4%, 6% and 8%) has a significant effect on the thermo-mechanical profile of gluten-free flours.



Anticipation of final product properties

A combination of several ingredients and processing aids have been tested on rice flour.

A synergistic effect was observed with the addition of these components, obtaining a high increase in dough consistency during mixing, which allowed the water addition to be increased to 110%. On this example, the formula includes rice flour as a basis, 13% soybean protein, 1% transglutaminase, and 4% HPMC. Using this combination, it is possible to obtain acceptable gluten-free, rice-based bread with increased nutritional value due to its higher protein content.



The Mixolab 2 is included in a US-patent

Method for the production of maize proteins and its use of said proteins for the production of gluten-free bakery products and pasta US patent US2012 0027890 A1.

Key publications

Marco C., and Rosell C. M., 2008, Breadmaking performance of protein enriched gluten-free breads. Eur. Food. Tes. Technol. 227:1205-1213.

Rosell C.M., and Marco C., 2007, Different strategies for optimizing rice based bread: ingredients, structuring agents and breadmaking process. Pages 155-158 in: Proc. RACI Cereal Chemistry Conf.

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CHOPIN TECHNOLOGIES

The CHOPIN RHEO F4 measures gas production, gas retention, and dough development - information critical to mastering the final volume and crumb density.

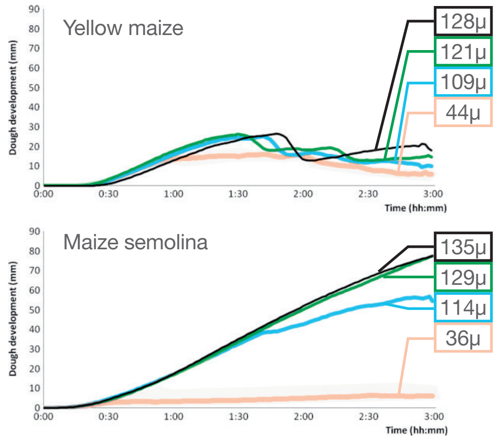
Selection of the raw material

The selection of the raw material is very important in relation to the final product quality.

The graph on the right shows the comparison of the granulation effect for two different maize (corn) products on the dough development vs. time.

Results show that the sample obtained from a yellow maize flour does not express a strong potential for dough development, whereas, flour obtained from semolina does.

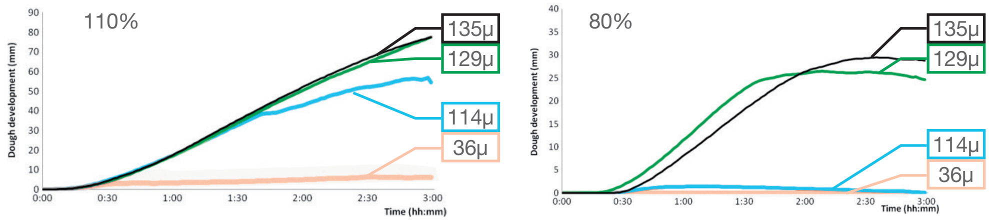
In both cases, it can be noted that the particle size affects the potential of the dough rising to an optimal level. This will have a large impact on the final product volume.



Measure the effect of the water level on proofing

The water level impacts the potential of the dough to develop during proofing.

The dough development curve on the right shows that particle size and water level impact on the volume of the final product.



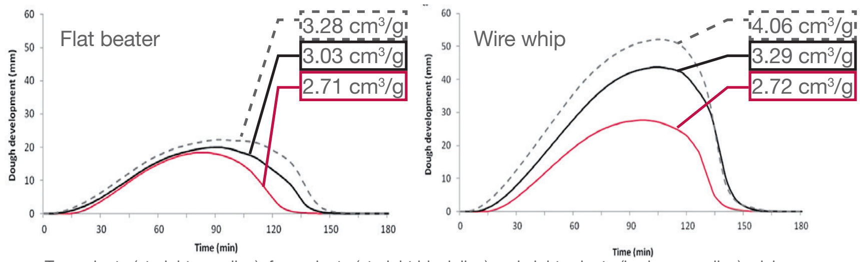
Adaptation of the mixer type and of the mixing time

The graphs to the right show the gas production of the same dough mixed using different conditions.

- Longer mixing leads to a better bread specific volume.

- Wire whip allowed the dough to reach better volumes than a flat beater for the same mixing time.

The Rheo F4 helps to optimize the mixing conditions resulting in a better bread volume.



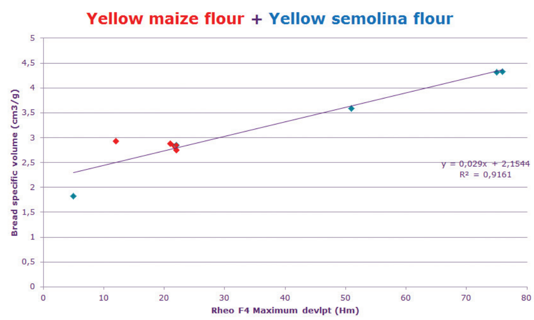
Two-minute (straight gray line), four-minute (straight black line) and eight-minute (broken gray line) mixing.

Anticipation of final product properties

The final volume is an important parameter to control as it directly impacts the consumer's appeal to the product.

Based on the Rheo F4 data, studies reveal that a good estimation of the following bread properties could be reached:

- Bread specific volume (the volume for 1 gram of bread).
- Bread hardness.
- Bread cohesiveness.
- Bread springiness.
- Bread resilience.



Key publications

De la Hera E., Talegon M., Caballero P., Gomez M., influence of maize flour particle size on gluten-free breadmaking, 2013, J Sci Food Agric; 93: 924-932.

Gomez M., Talegon P., De la Hera E., influence of mixing on quality of gluten-free bread, 2013, Journal of food quality, 36:139-145.

CHOPIN Technologies proposes two unique instruments, perfectly adapted to gluten-free formulation, quality control and prediction. These tools allow users to efficiently control dough mixing properties, proofing, and baking behavior.

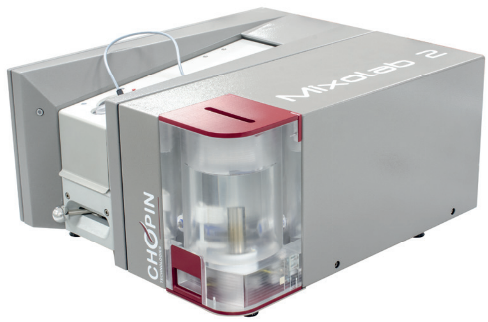
The Mixolab 2

The Mixolab 2 measures the consistency of the dough submitted to the dual constraint of constant mixing and temperature changes (heating/cooling cycle).

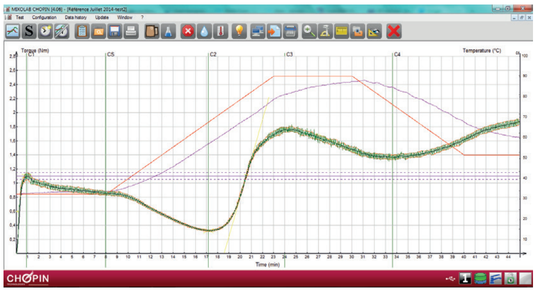
Any kind of dough or formulation can be analyzed thanks to the unit's versatility. The test protocol can be customized to any users' needs.

The first part of the curve (constant temperature) gives information on the dough rheology (water level, consistency, stability...).

The second part of the curve (Heating/cooling) gives critical information on starch gelatinization and retrogradation (product shelf life), allowing users to obtain information in complex formulations, which reflects the exact behavior of the dough on the processing lines.



Point	Explanation	Associated parameters	
C1	Used to determine water absorption	T°C 1 and T1	Dough temperature and time corresponding to the occurrence of the various torques
C2	Measures protein weakening as a function of mechanical work and temperature	T°C 2 and T2	
C3	Measures starch gelatinisation	T°C 3 and T3	
C4	Measures hot gel stability	T°C 4 and T4	
C5	Measures starch retrogradation in the cooling phase	T°C 5 and T5	



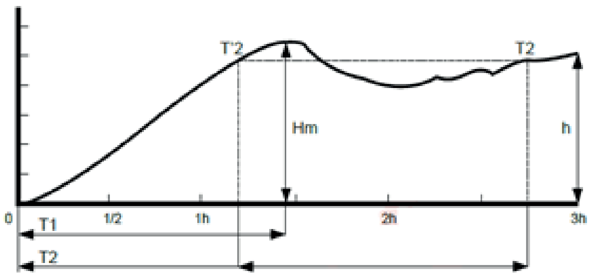
The Rheo F4

The Rheo F4 constantly measures the pressure in a sealed temperature-controlled tank in which the dough is placed. During the "direct circuit" cycle, the device provides information about the total gas production (yeast activity). During the "indirect circuit" cycle, it measures the retention of gas, in other words, the porosity of the dough.

A sensor above the dough indicates its development and stability to determine the optimal time for placing the dough in the oven.

Results of the dough development curve:

- Hm : maximum dough development correlated with the bread volume.
- T1 : Time necessary to reach the maximum development, in relation to the yeast activity and dough rheology.
- T2 – T'2 : Time relative to the dough stability around Hm, correlates with the dough tolerance to proofing and the optimal time for putting the dough in the oven.



Results of the gas production/retention curve:

- H'm : Maximum height of the gas production curve.
- T1 : time to reach H'm.
- Tx : moment when the dough starts to lose CO_2 produced by yeast.
- Total volume : Total gas production by yeast.
- Lost CO_2 volume: volume of carbon dioxide that the dough allows to escape during proofing (A2).
- Retention volume: Volume of carbon dioxide still retained by the dough at the end of the test (A1).