Evolution of flour properties during storage under different temperatures

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PRESENTATION

In the cereal industry, it is often necessary to store flours for an indefinite amount of time. According to the quality of the infrastructures, it is sometimes difficult to ensure a proper storage environment for cereal products which can affect the properties of flours. The objective of this study is to evaluate the evolution of the rheological properties and functionalities of flours during storage under different conditions.

MATERIAL AND METHODS

Samples of wheat (Apache) were milled using the CHOPIN CD1 experimental mill. Two different milling processes were used in order to obtain white flour and whole meal flour (standard protocol: AACC 26-10.02 and adapted protocol for making whole meal flour).

Both samples were separated in three fractions which were stored under three different temperatures (4°C, 20°C and 30°C) all other conditions being equal (same container type, not watertight to allow water evaporation and kept in the darkness to avoid uncontrolled oxidation).The moisture content (NF EN ISO 712) and rheological quality of those samples was followed during four months every two weeks:

• Mixing and pasting behaviors were assessed according to the Chopin+ protocol using the Mixolab® (AACCI Method 54-60.01). Derived parameters such as water absorption capacity, protein weakening (C2), viscosity peak (C3), amylase activity (C4) and starch retrogradation (C5) were determined.

• Solvent retention capacity profiles were assessed using the SRC-CHOPIN®. Derived parameters such as Water (Wa), Sucrose (Su), Lactic Acid (LA) and Sodium Carbonate (SC) Solvent Retention Capacity (SRC) were determined.

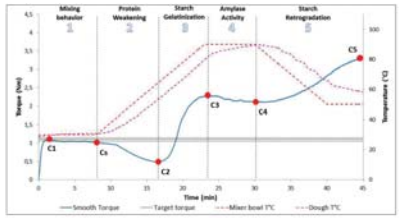

Figure 1: Mixolab curve obtained with the standardized "Chopin+ protocol" (80 rpm) 5 different phases.

With

C1: 1st Maximum
Cs: Torque measured when the heating starts
C2: 1st Minimum
C3: 2nd Maximum
C4: 2nd Minimum
C5: Final point of the curve

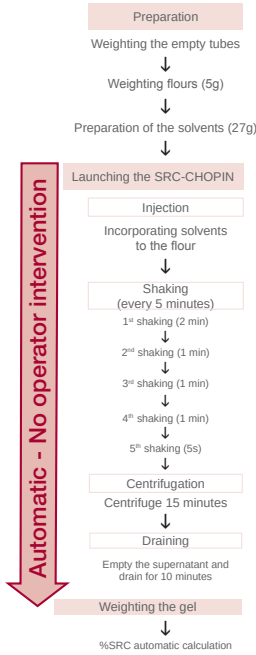

Figure 2: Process for running the SRC-CHOPIN.

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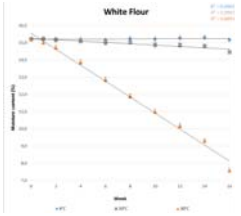
RESULTS & DISCUSSION

Moisture content was highly impacted over time by the storage conditions (**Figures 3 & 4**) for all the tested flours:

- At 4°C: No significant change was detected after 16 weeks of storage
- At 20°C: The moisture content gradually decreased. This phenomena becomes significant from week 10.
- At 30°C: The moisture content was strongly impacted. The decrease becomes significant from the 2nd week.

Mixolab and SRC-CHOPIN testing adjusts for moisture content, the following variations are not due to a simple loss of water.



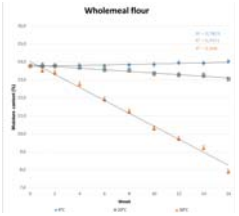
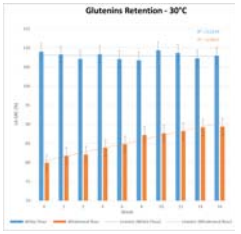


Figure 3 and 4: Moisture content evolution. White flour on the left ; Wholemeal flour on the right.

First, it should be noted that no significant change is detected at 4°C for the white flour whatever the type of measurement.Second, the SRC results show that the retention capacity of the glutenins (LA) for the whole meal flour increases while it remains stable for the white flour (**Figure 5**). The pentosans retention capacity (Su) increases linearly at 30°C whatever the type of flour tested (white flour: R^2=0.87; whole meal flour: R^2=0.95) (**Figure 6).**



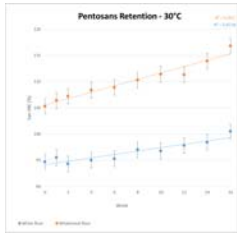


Figure 5 and 6: White Flour and Wholemeal flour comparison – 30°C Storage – Glutenins Retention capacity evolution on the left, Pentosans on the right.

Third, the Mixolab results show that whatever the flour and the temperature, the storage induces an increase of the stability (+37% on average) (**Figure 7**) and an increase of the gelatinization intensity. It is also very interesting to notice that storing the whole meal flour at 30°C causes a loss of the recorded signal in the end of the Mixolab test from the 8th week (**Figure 8**). This is due to the dough separating in two parts and not being properly mixed. Further studies will need to be conducted to explore this phenomena.

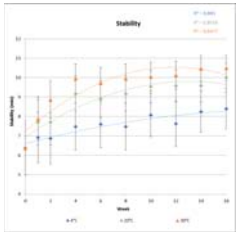


Figure 7: Stability evolution (Whole meal flour).

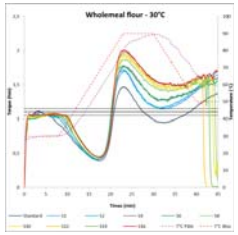


Figure 8: Mixolab curves obtained for whole meal flour stored at 30°C.

CONCLUSION

The study shows that the flours properties are changing during storage. Those changes depend on the type of flour and on the storage conditions. Storing a flour at 4°C has no impact during at least 4 months. In general, whole meal flour is more sensitive to the storage impacts than white flour which is consistent with the literature. The findings show that there is still a lot to understand on the impact of storage conditions on the rheological properties of wheat flours. The Mixolab measures the evolution of the rheological properties while the SRC permits the measurement of the functionality of a stored flour.