STUDY OF CRYSTAL MELTING KINETICS OF HONEY DURING LOW HEATING CONDITIONS

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Honey has a tendency to crystallize rapidly after extraction, and, in several countries, the majority of consumers prefer liquid honey. However, methods which are currently used to avoid the crystallization process and keep honey in a liquid state generally induce an increase in hydroxymethylfurfural (HMF) content and a decrease in enzymatic activities. And, high content of HMF and low enzymatic activities indicate a degradation of honey. The aim of the present work was to study the evolution of honey granulation during low heating conditions in order to obtain liquid honey with less degradation as possible. Inspired by a previous work [1], we used absorption spectrophotometry to calculate crystal melting rates. Moreover, the use of polarized light microscopy allowed us to observe, in real time, crystal melting.

Absorption

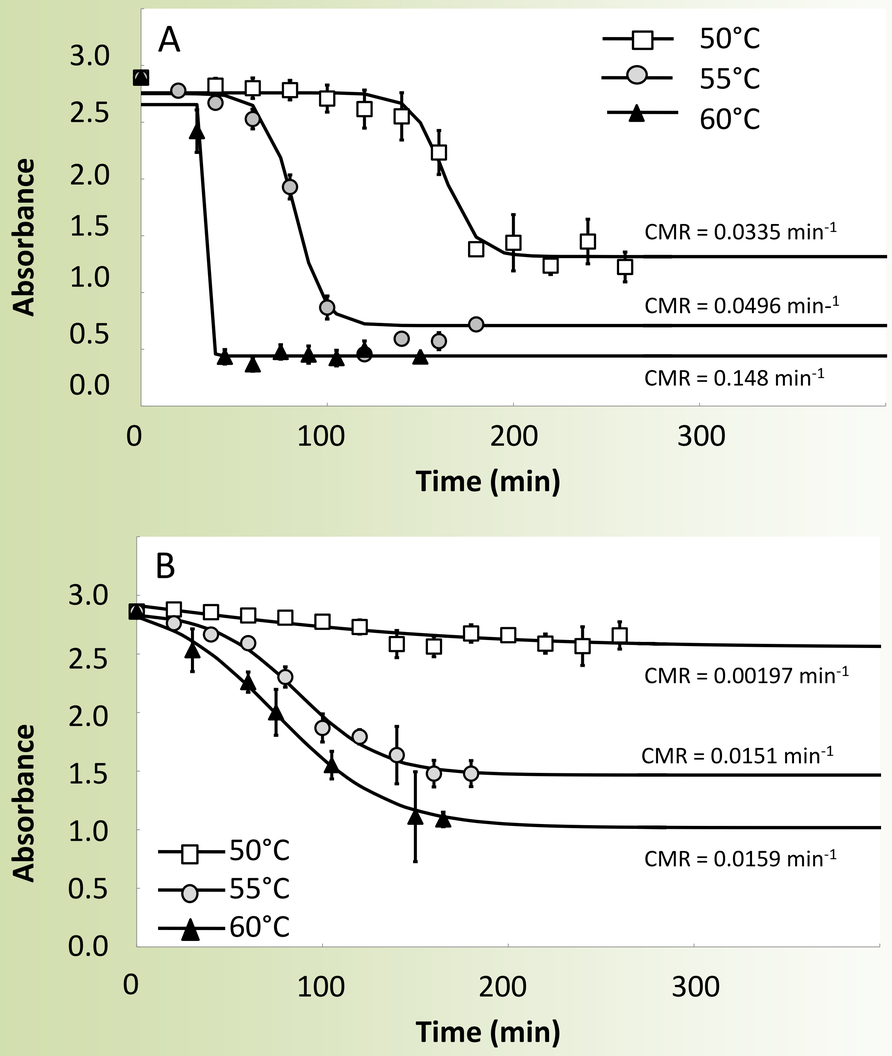

Figure 1 A and B: crystal melting kinetics for rape (A) and sunflower (B) honeys under low heating conditions at 50°C ■, 55°C●, and 60°C▲, crystal melting rates (CMR) are indicated in min^{-1}

Spectrophotometry

Crystal melting can be modelled into a sigmoid function and divided into 3 phases

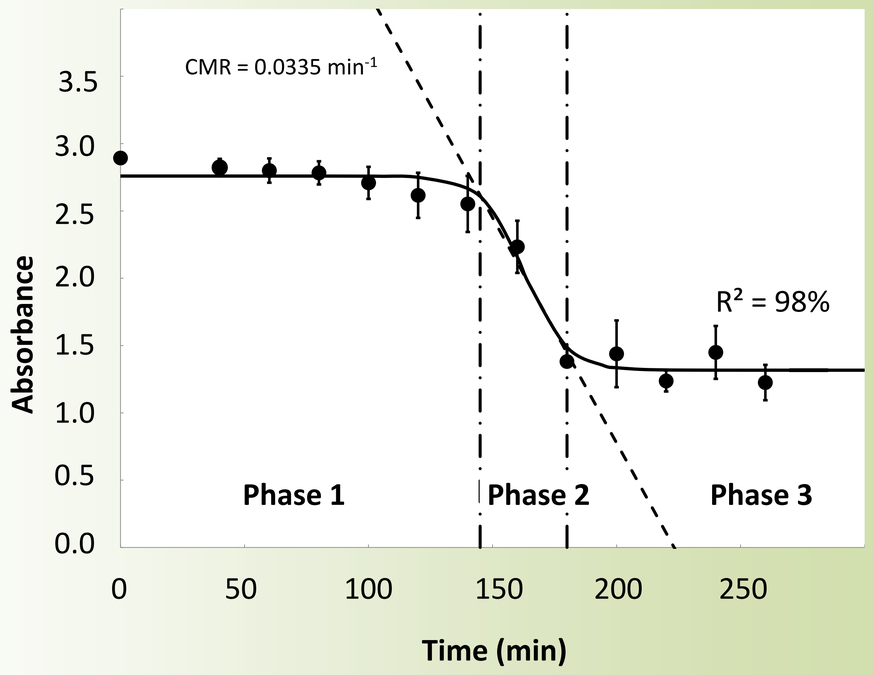

Figure 2: crystal melting kinetic for rape honey at 50°C modelled in a sigmoid curve and representation of the linear function in phase 2 enabling calculation of crystal melting rate

Crystal melting rates for rape honey are significantly higher than for sunflower honey

- **Phase 1**: crystals accumulate energy necessary to their dissolution
- **Phase 2**: crystals are melting
- **Phase 3**: crystals have melted, honey is liquid

Polarized light microscopy

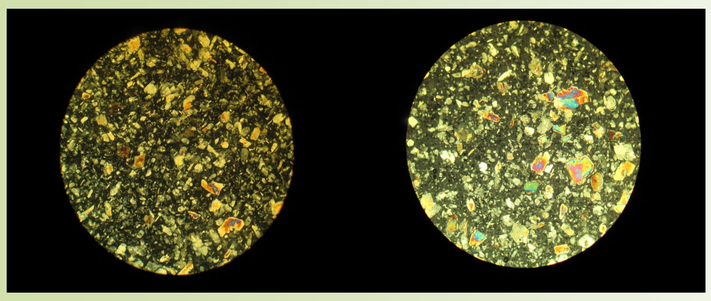

Figure 3: pictures of rape honey (on the left) and sunflower honey (on the right) at room temperature (20°C) and under polarized light microscopy (X125)

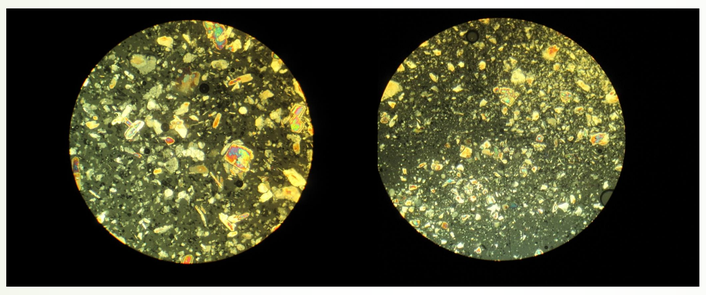

Figure 4: pictures of sunflower honey during heating at 60°C under polarized light microscopy (X125), after 10 min (on the left) and 20 min (on the right)

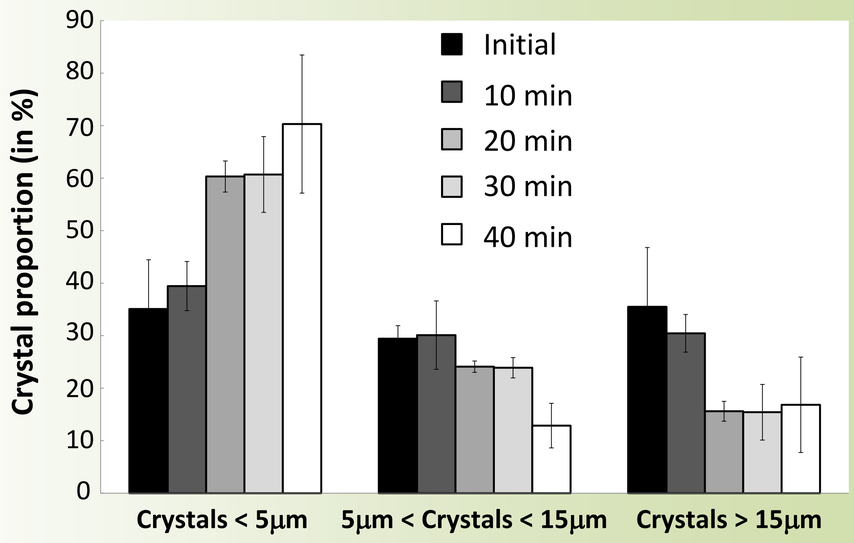

Figure 5: evolution of crystal proportion (in %) over time, depending on their size range, for sunflower honey at 60°C

Higher crystal melting rates for rape honey can be explained by the fact that crystals are smaller than in sunflower honey

This observation confirms that the decrease of absorbance during heating is directly related to crystal melting

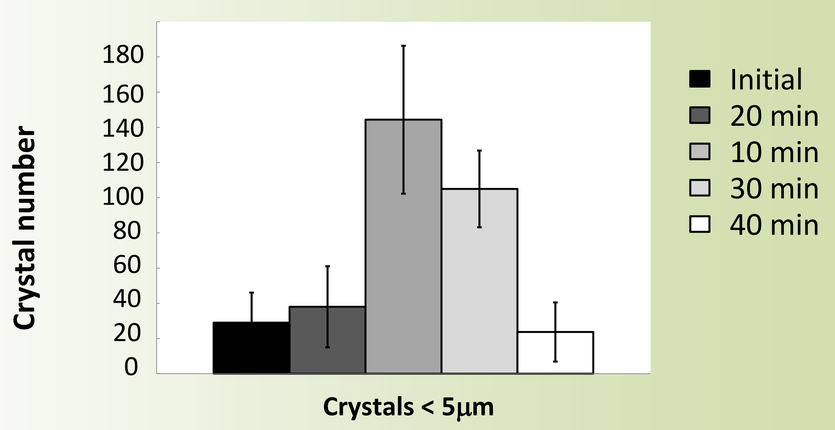

Figure 6: evolution of crystal number over time, for crystals smaller than 5 µm, for sunflower honey at 60°C

To conclude, in practical terms, this study allowed us to find, in low heating conditions, the minimal period necessary to obtain liquid honey for rape and sunflower honeys at given temperatures. But, above all, this work, by the use of two complementary techniques, allowed to understand better a very little studied field until now: granulation of honey under heating conditions.

Crystal count revealed that during heating bigger crystals melt to become smaller before disappearing

[1] Lupano C.E. (1997) DSC study of honey granulation stored at various temperatures, *Food Res. Int. 309, 683-688.*