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Physical and structural characterization of creamed honey obtained by a guided crystallization process

Honey Technology online seminar

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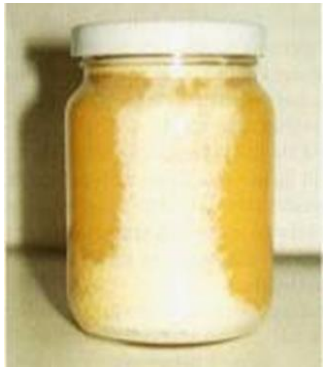
Honey crystallization: good or bad?

Honey crystallization (granulation): natural phenomenon by which honey turns from a liquid to semi-solid state with granular composition

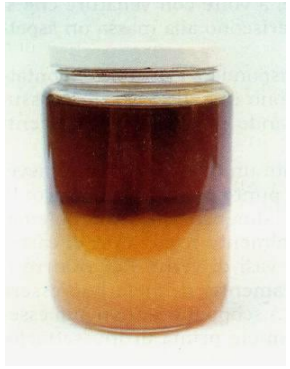
Often considered as a **defect** for **commercial honeys**

Retraction spots



Incomplete crystallization

Phase separation



Honey fermentation

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What is guided crystallization? – Creamed honey

Controlled crystallization

used to obtain creamed (or set) honey

Patented by Elton J. Dyce in 1935 (U.S. Patent 1,987,893)

Honey Process and Products – Cornell University

uses a crystal seed to initiate the process

Creamed Honey: crystallized in a controlled manner, so that it remains soft and spreadable.

It generally has a sweeter taste, and a lighter color.

characterized by a very smooth texture

Dyce method

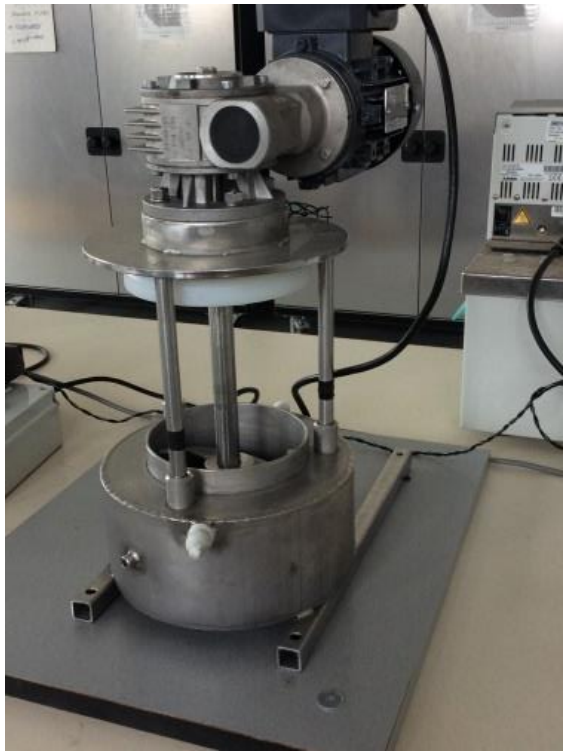
Pasteurization	• 160 °F / 70 °C • [illegible]asts de[illegible]dation
Cooling	• Below 75 °F/23 [illegible]
Crystal addition	• Finely granulated honey crushed in a grinder • 3-10% - most common 5%
Mixing	• 15 min • Stirring from the bottom of the mass
Storage	• 57 °F/14 °C • Constant temperature – 34 h

Static method

Dynamic method for guided crystallization

Preparation of crystal seed	• granulated honey crushed in a pump
Crystal addition	• 3-10% - most common 5%
Constant Mixing	• Storage at 14 °C

In-house Prototype
Volume: 1.5 L
Rotation rate: 14 rpm



Honey samples

Samples with different crystallization trends/rates

Crystallized honey sample (Crystal seed):
• Citrus

Liquid Honey samples:
• selected by Piana Ricerca e Consulenza S.r.l. laboratory (Italy),
•Mixture of Sunflower and Citrus

Classification:
Fast crystallization: F/G < 1.2 **FC**
Medium crystallization: 1.2 < F/G < 1.4 **MC**
Slow crystallization: F/G > 1.4 **SC**

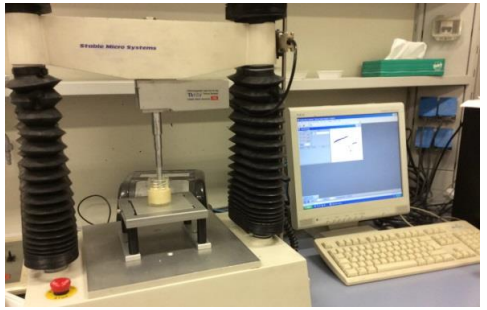
Samples composition (g/100 g) expressed as mean value ± standard deviation.

Sample	Fructose	Glucose	Sucrose	Turanose	Maltose	Water	F/G
FC	39.2 ± 4.3	36.2 ± 4.6	< 0.5	0.8 ± 0.1	1.4 ± 0.2	17.7	1.08
MC	38.6 ± 4.2	32.5 ± 4.2	0.5 ± 0.1	0.8 ± 0.1	1,1 ± 0.1	16.5	1.20
SC	38.0 ± 4.1	27.1 ± 3.7	< 0.5	1.1 ± 0.1	0.8 ± 0.1	17.3	1.45

Physical and structural characterization

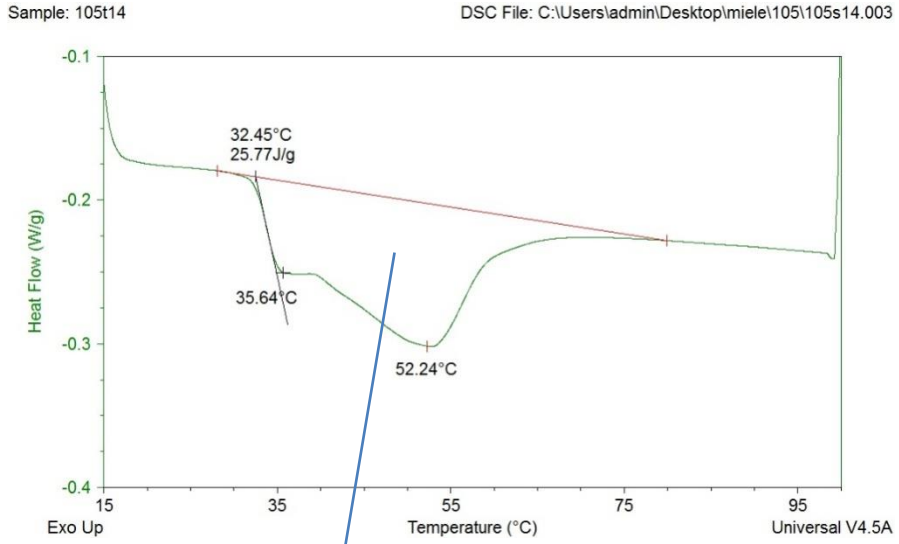
Preparation:
- Gentle heating
- Crystal seed addition (5%)
- Mixing
- Storage (static or dynamic)

Characterization:
- DSC (DSC Q20 TA Instrument, heating from 14 to 90°C at 5°C/min)
- Texture (TA-HDi Texture Analyser, Stable Micro System, compression test (Conforti et al., 2006)
- Rheology (MCR 300, Physical/Anton Paar, plate-plate geometry PP50)
- Colour (Spectro-photcolorimeter HUNTER LAB Color-FlexTM)
- Crystal size (Nikon optical Microscope with polarized filter)

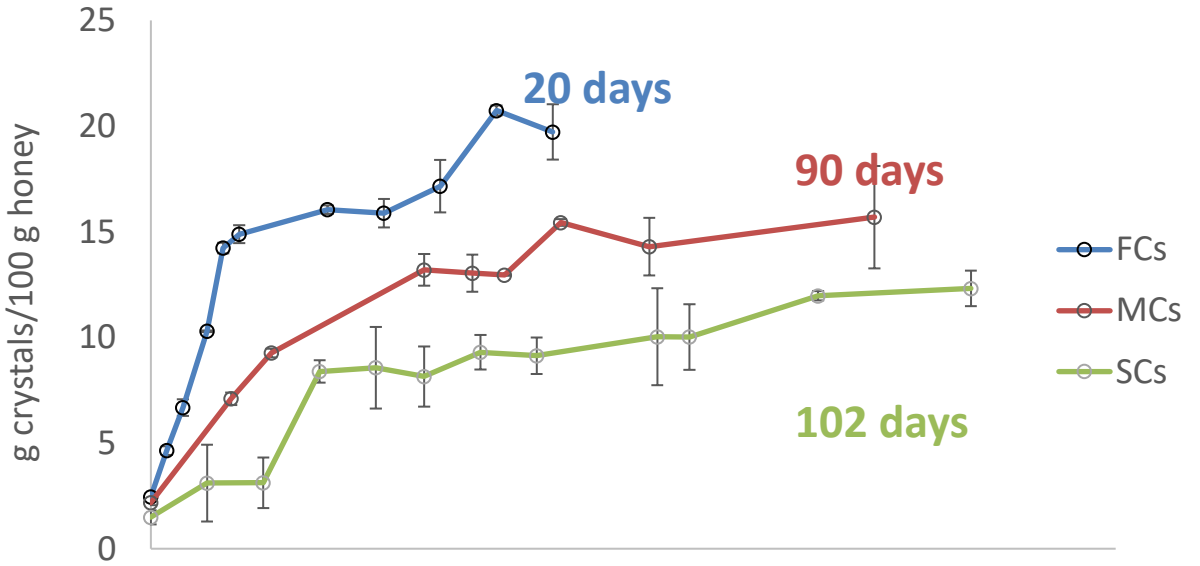


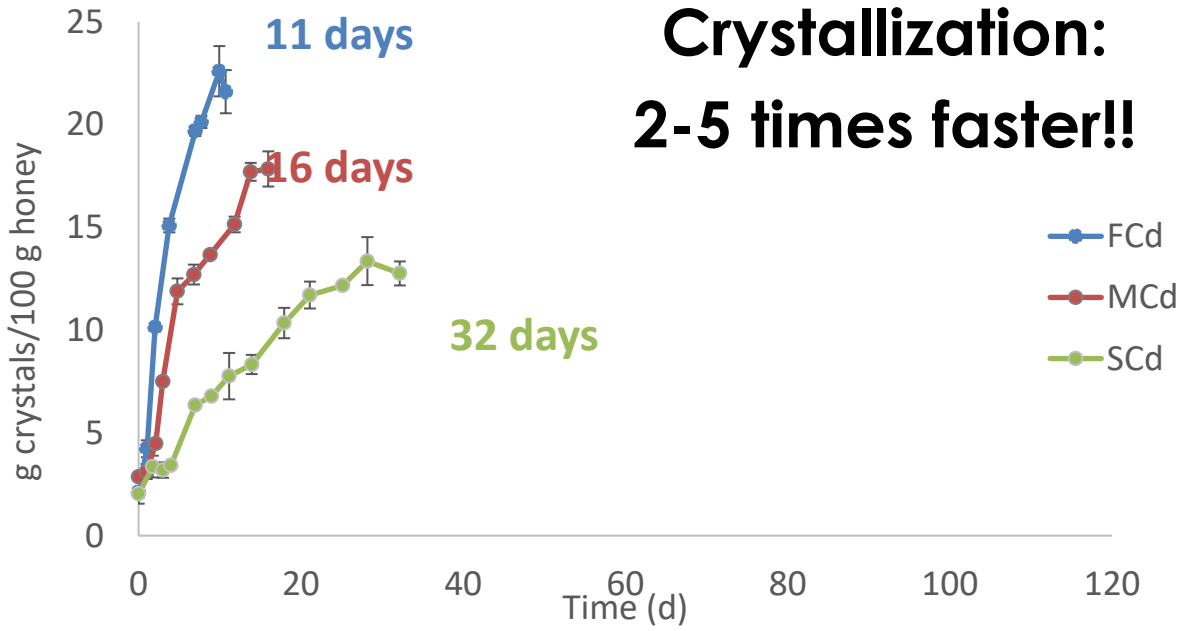
Crystallization kinetic: Static versus Dvnamic

Differential Scanning Calorimetry



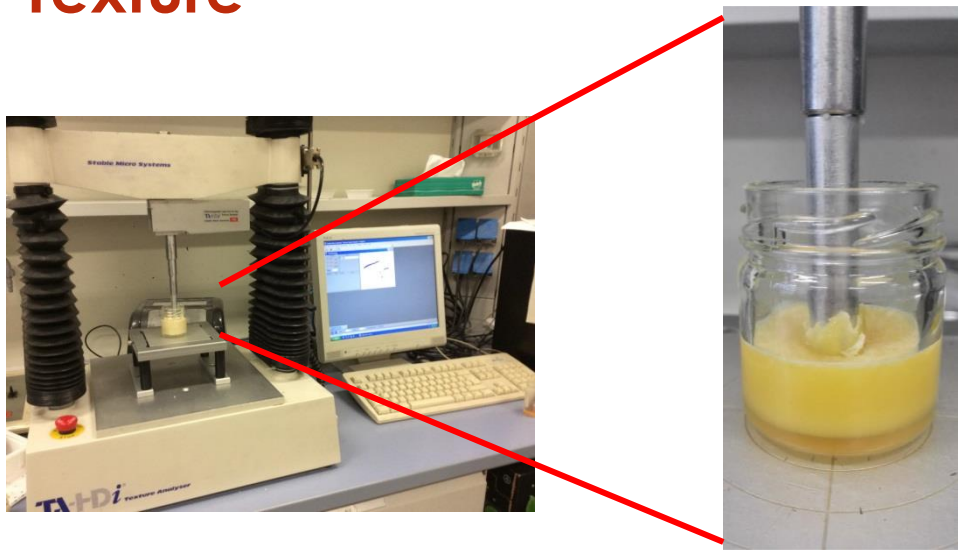
Specific melting enthalpy of glucose crystals = 176 J/g

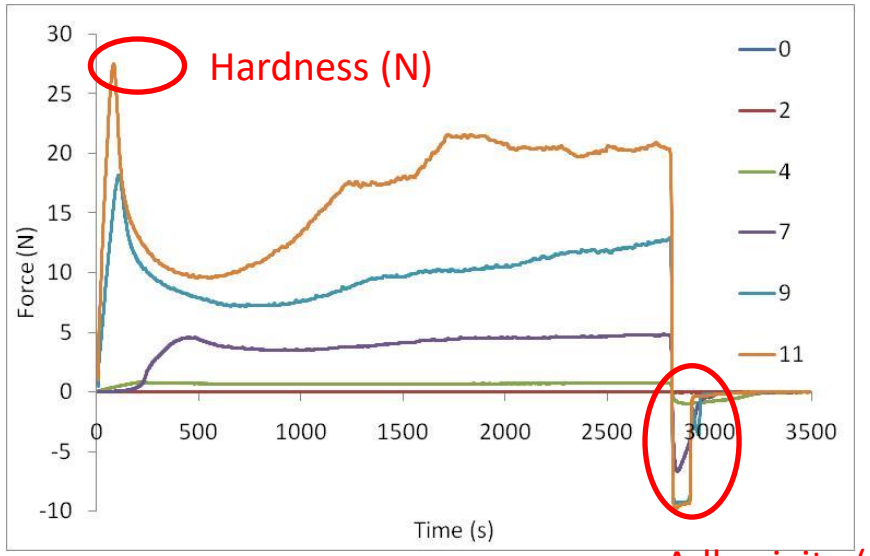




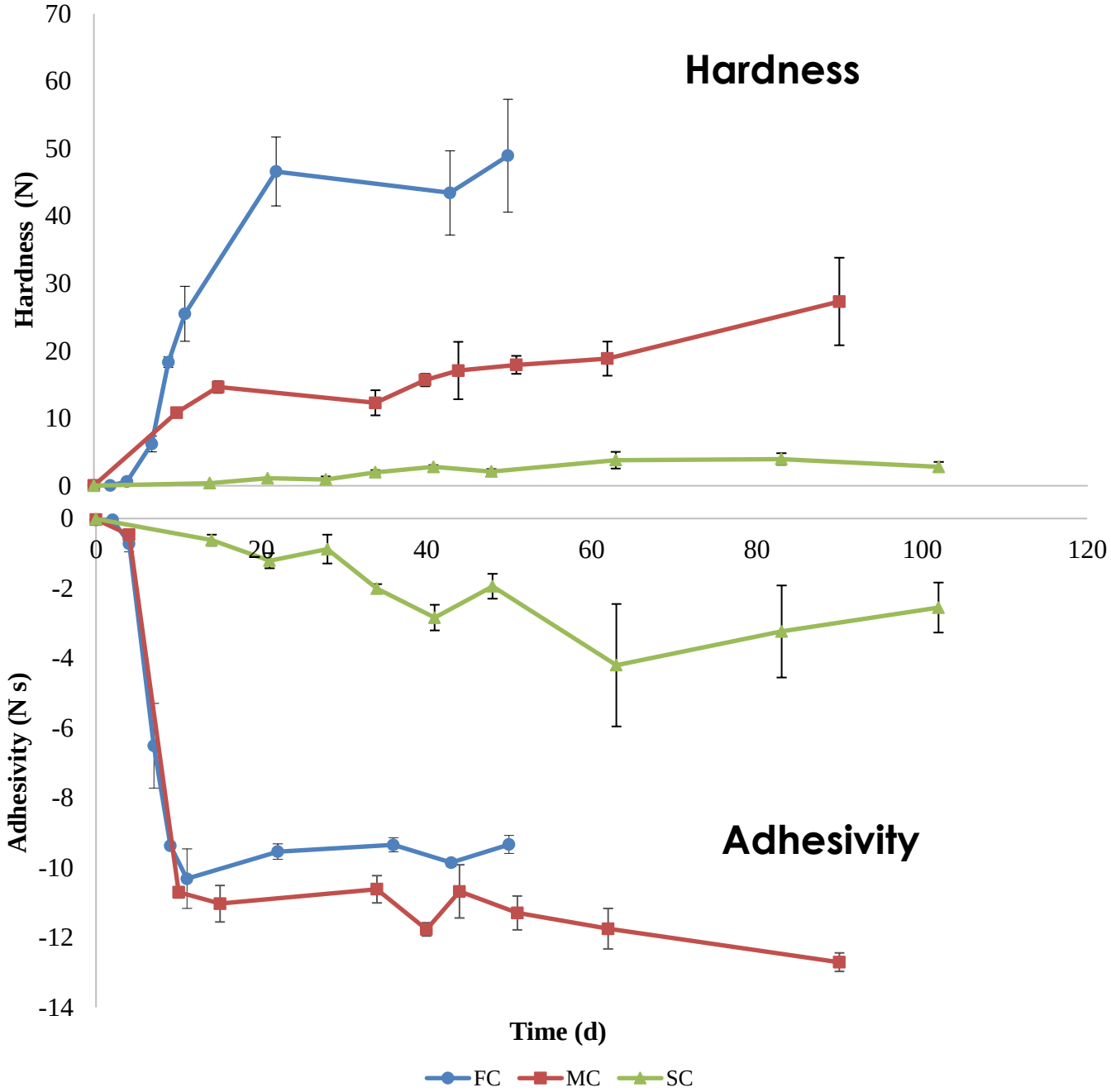
Crystallization: 2-5 times faster!!

Texture

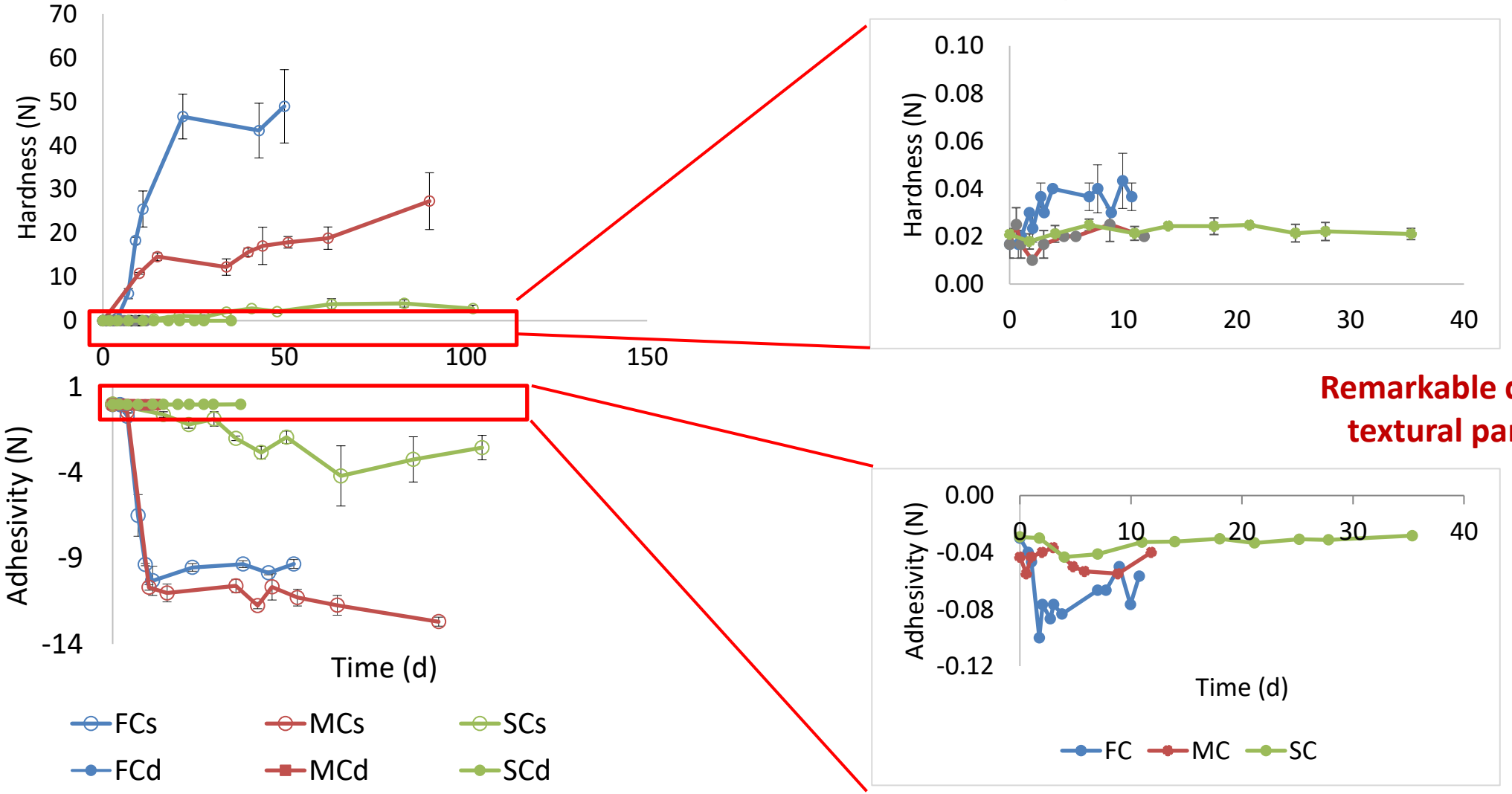




Texture profile evolution of a static honey during storage time

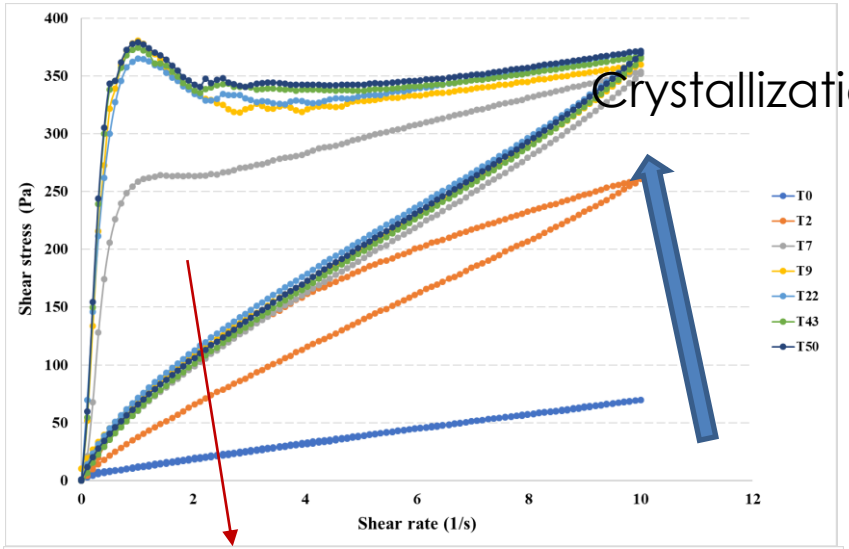


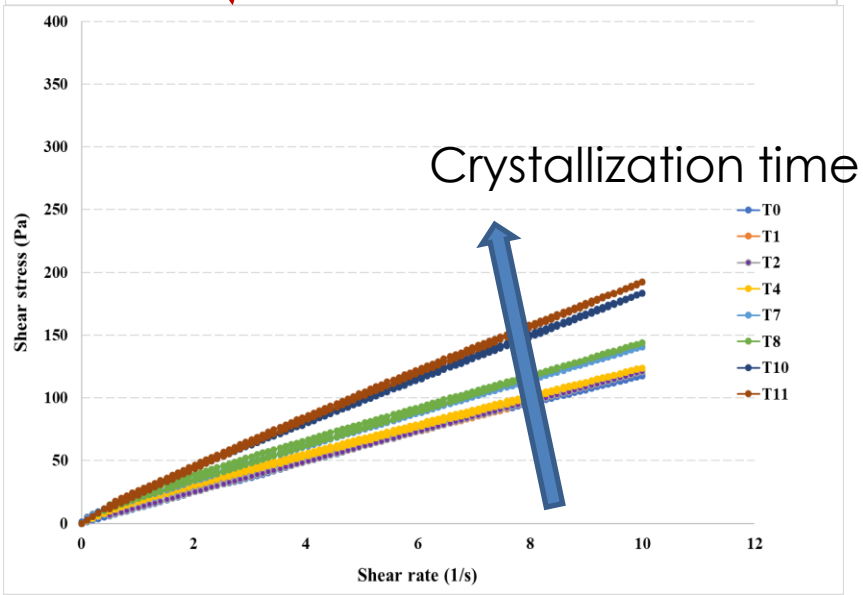
Texture – Static vs Dynamic mode



Remarkable difference in textural parameters!!

Viscosity – Rheological behaviour





Liquid honey ➔ **Newtonian fluid**

Crystallized honey ➔ non-Newtonian fluid

Viscosity (Pa s) of honey samples at the beginning and at the end of the static or dynamic crystallization process

Sample	initial value	final value	
		static	dynamic
FC	7.14 ± 0.89^{a}	182.04 ± 9.59^{a}	37.67 ± 3.22^{a}
MC	8.87 ± 2.28^{a}	61.44 ± 8.49^{b}	17.50 ± 0.34^{b}
SC	7.58 ± 1.06^{a}	45.58 ± 17.02^{c}	14.77 ± 4.24^{c}

Different letters indicate significant differences along the same column at $p<0.05$

LOWER VISCOSITY

Dynamic method ➔ Modification of rheological behaviour during crystallization!!

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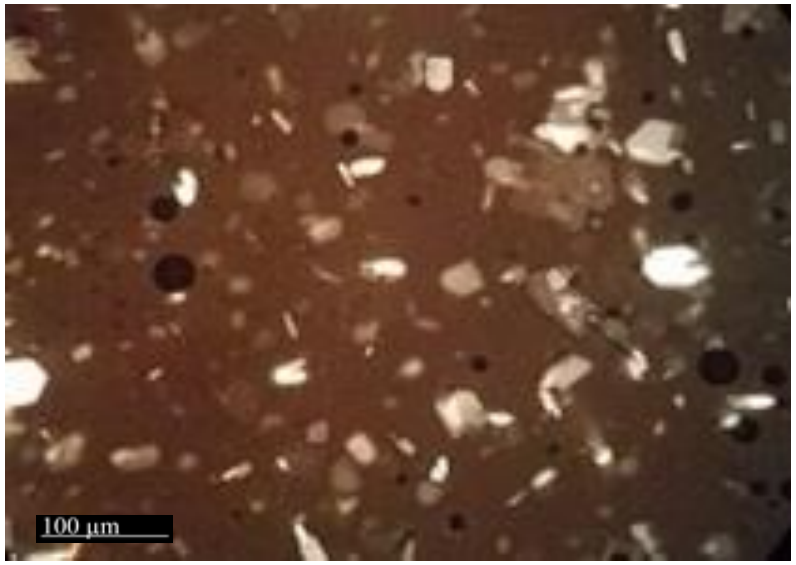
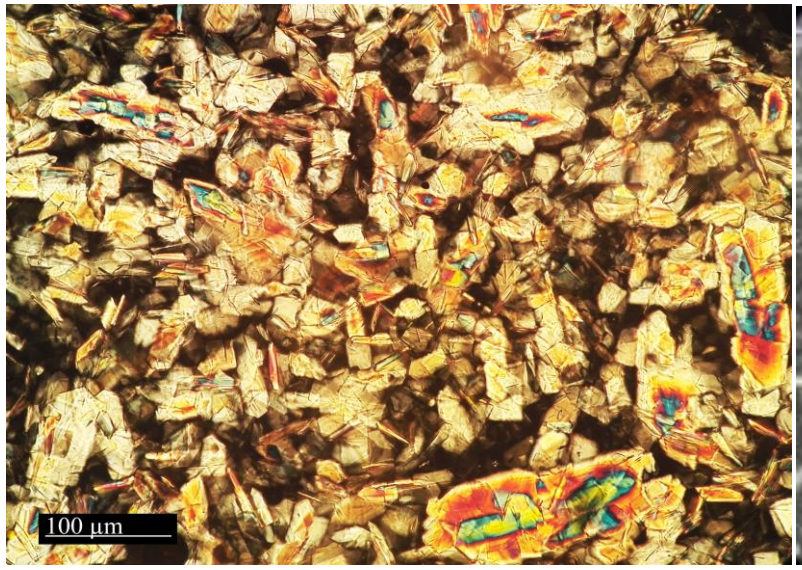
Crystal size

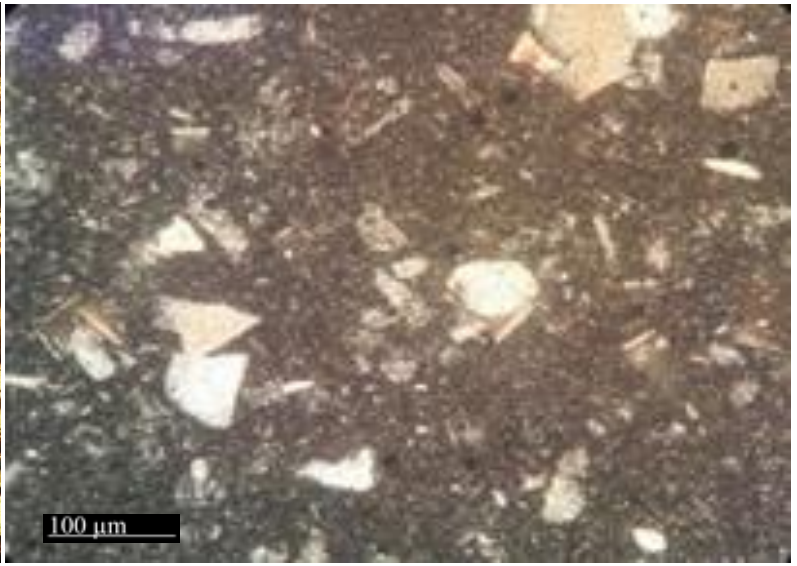
Optical microscope with polarized light – Magnification 40x



Liquid honey with
added crystal seed

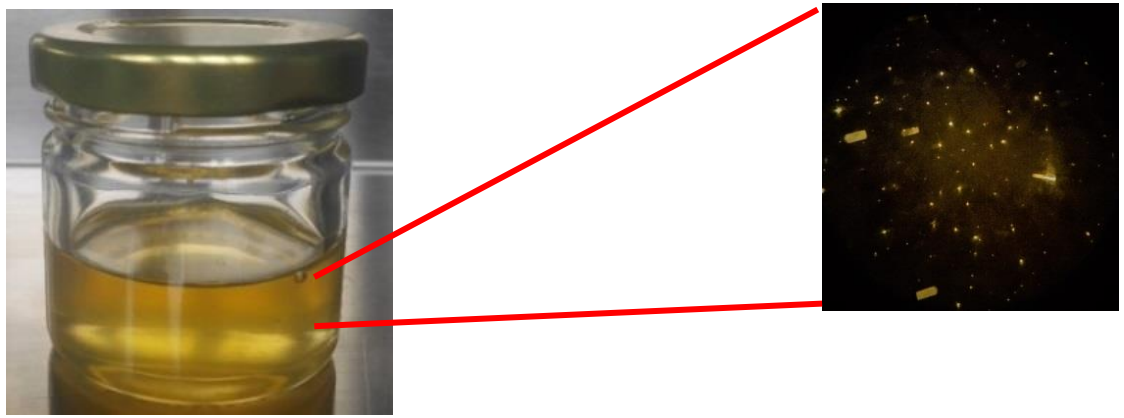


Crystallized honey
Static method

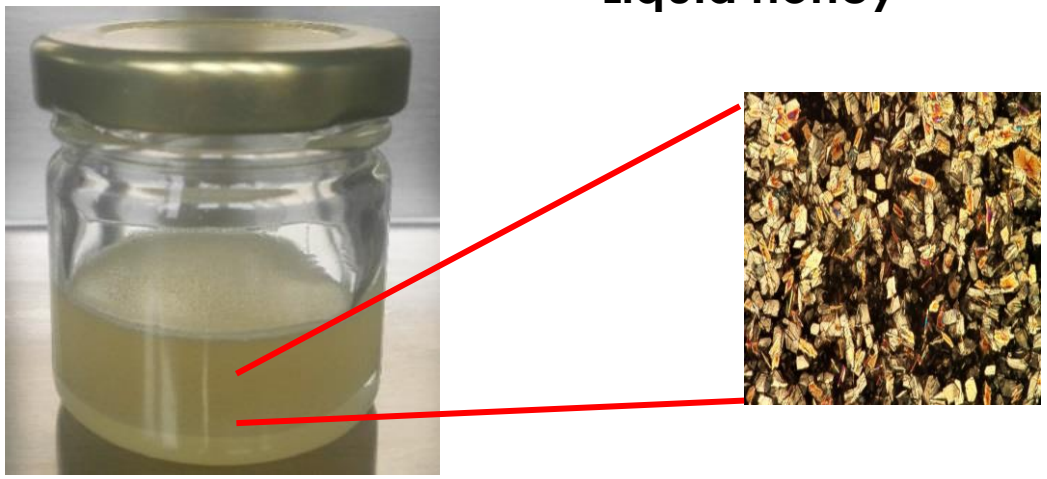


Crystallized honey
Dynamic method

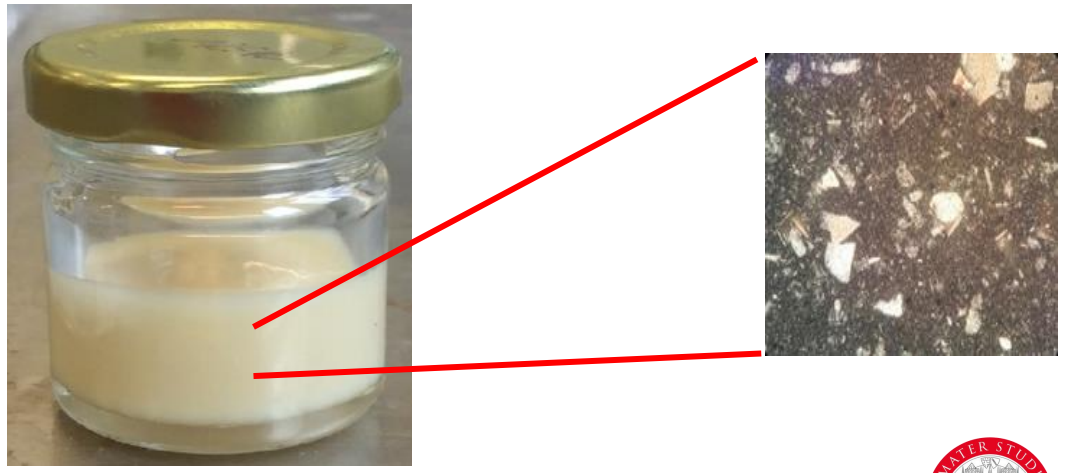
Effect of crystal size on colour



Liquid honey

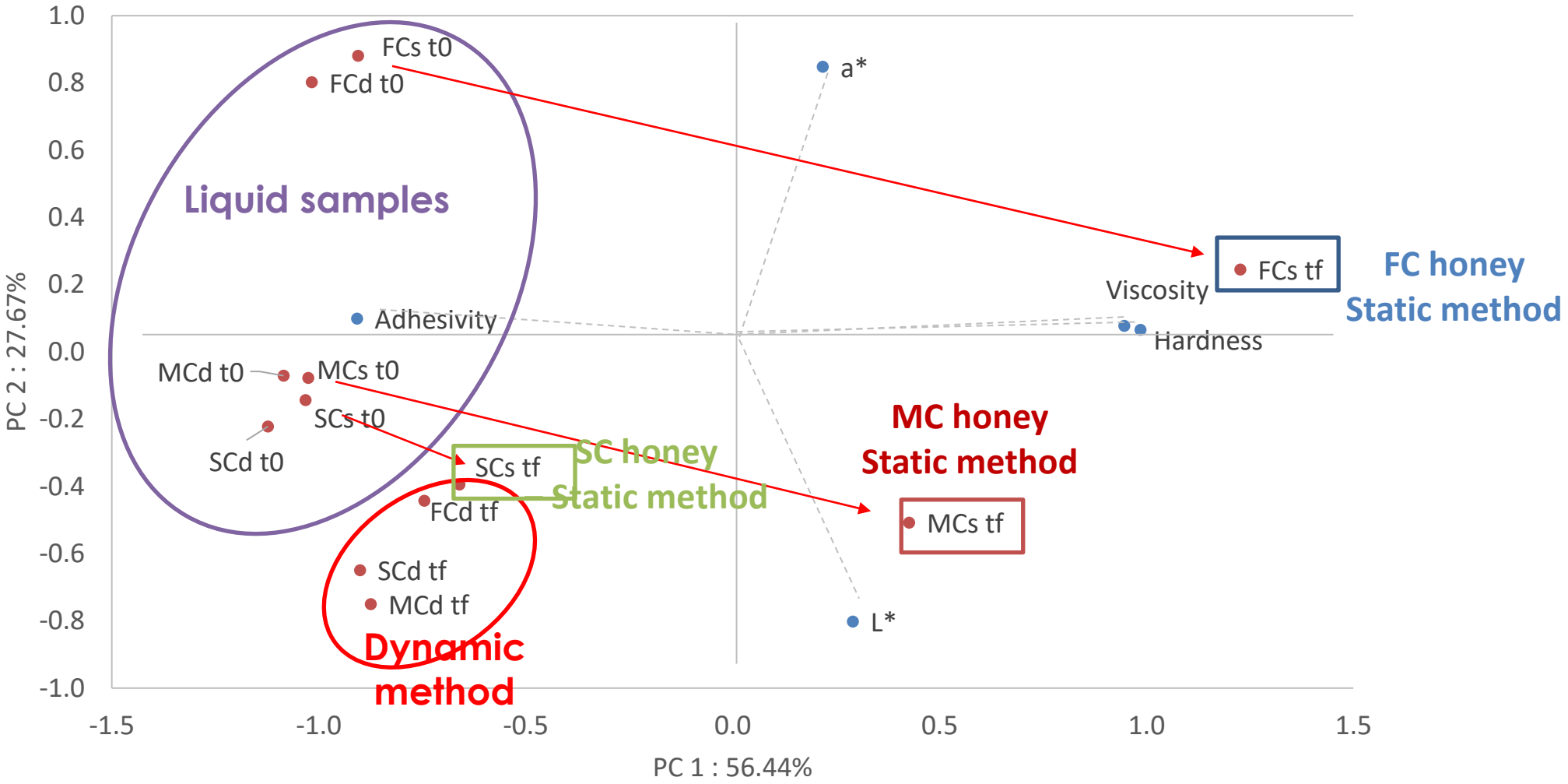


Crystallized honey
Static mode



Crystallized honey
Dynamic mode

Principal component analysis



Conclusions

Guided crystallization: strategy to avoid crystallization defects

Traditional static method: final products characteristics depends strongly on the composition of the initial honey

Dynamic method allows to obtain a product:

- characterized by a smooth and creamy texture, with all tested honey types
- with final characteristics very similar and homogeneous
- stable during storage (fully crystallized)
- with peculiar sensorial characteristics – needs specific marketing strategy

Thank you for the attention!!

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