Puff pastry margarines performances related to their physicochemical properties

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I. Introduction

The functionality of margarines and shortenings as bakery ingredients depends on several factors. Formulation and processing are both key factors affecting the performances of the final products. Specifically in puff pastry margarines (PPM), the fats must present some special technical functionalities such as plasticity. In this work, fully palm-based PPM (~0.5% TFA) have been made on a laboratory scale. These laboratory margarines, as well as commercial margarines (with TFA ~5% and low TFA ~0.5%) have been characterized both physicochemically and chemically. The bakery aptitudes of these PPM (commercial and laboratory) have also been determined. The effect of temperature post-crystallization (for 48h after production) on product properties has been studied.

II. Material and Methods

Commercial samples of PPM were studied, with different TFA contents (D-G). On a laboratory scale PPM were produced with palm fractions (Palm Oil, Palm Stearin and Palm Superolein) (1-4). Several analysis have been realized to characterize these different margarines:

- Mettler dropping point,
- hardness by texturometry,
- melting profile with solid fat content (SFC) by pRMN,
- polymorphism by powder X-ray diffraction (XRD),
- baking ability by preparing puff pastry cases (‘vol au vent’) with margarines and by measuring the height of the puff pastry cases before and after cooking.

III. Results

Margarines

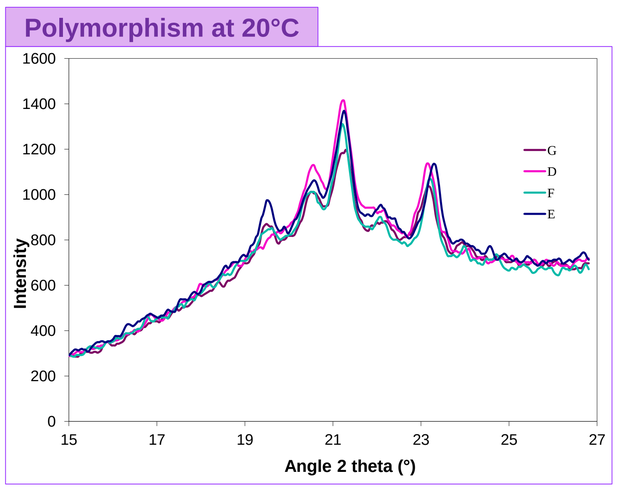
Dropping point (°C)

	Samples	Dropping point (°C)
Commercial	D (TFA 2.9%)	45.6
	E (TFA 4.4%)	45.4
	F (TFA 0.7%)	47.9
	G (TFA 0.9%)	49.8
Laboratory	1	49.7
	2	47.1
	3	47.0
	4	48.7

Hardness at 20°C

	Samples	Hardness (g)
Commercial	D	395.8
	E	237.9
	F	239.6
	G	428.6
Laboratory	1	615.7
	2	563.5
	3	461.4
	4	495.1

Polymorphism at 20°C

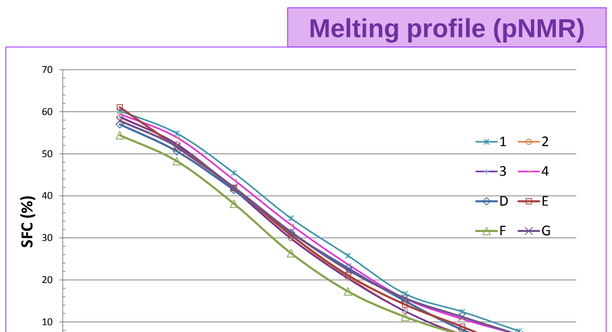


Margarines fat phases

Polymorphism at 15°C

	Samples	Polymorphism (after 3 weeks)
Laboratory	1	β’+ β (<10%)
	2	β’+ β (<<10%)
	3	β’+ β (<<10%)
	4	β’+ β (<10%)

Melting profile (pNMR)



Baking ability

	Samples	Plasticity	Height development
Commercial	D	brittle	5.3
	E	very good	7.7
	F	soft and sticky	4.2
	G	very hard and brittle	5.2
Laboratory	1	hard	4
	2	good	3.5
	3	hard	3.5
	4	good	3
	Same as D	good	3


D


G


Laboratory D


1


2

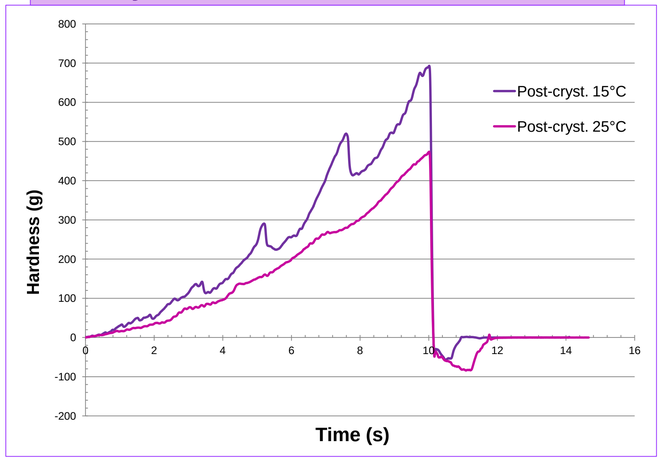

3


4

Post-crystallization influence

One of these formulations has been produced on a pilot scale (Schroëder apparatus with a scraped surface heat exchanger) in order to study the post-crystallization influence. A part of the produced sample has been post-crystallized at 15°C for 48h and another part at 25°C for 48h. After post-crystallization all the samples have been stored at 15°C.

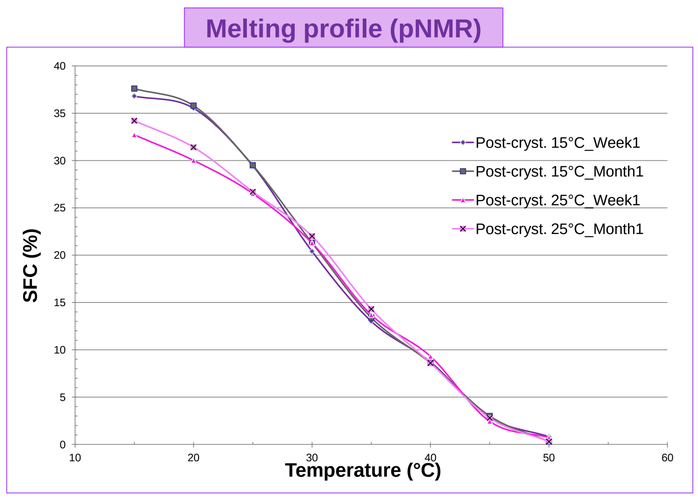
Post-crystallization effect on hardness at 15°C



Hardness at 20°C

Storage	Post-cryst.15°C	Post-cryst. 25°C
1 week	542,6	338,5
1 month	516,6	325,4

Melting profile (pNMR)

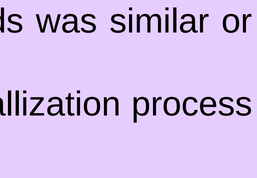


Baking ability

Post-cryst.15°C


↳ height development ~3

Post-cryst.25°C


↳ height development ~5

Polymorphisme at 15°C

Storage	Post-cryst.15°C	Post-cryst. 25°C
1 week	β'_1	β'_1
2 weeks	β'_1	β'_1

⇨Post-crystallization effects are important on the product properties:

- margarines are harder after a post-crystallization at 15°C for 48h (after 1 week, ~630g against ~460g for a 25°C post-cryst.)
- after a post-crystallization of 48h at 25°C margarines present a lower melting profile before 30°C
- margarine’s plasticity is different : a post-crystallization at 15°C makes margarine brittle as observed in texture profiles and by preparing the puff pastries. This poor plasticity negatively influences baking ability of the 15°C post-crystallized margarine.

IV. Conclusion

Physicochemical properties depend on the product formulation. However, according to these results, the functionality of the palm-based blends was similar or even better compared to the commercial references (cf baking ability of laboratory margarines).
It was shown that the post-crystallization temperature of margarines strongly modifies their bakery performances. The control of this post-crystallization process is of crucial importance for such products.

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