COMBINING FAT AND WAXES IN HYBRID SYSTEMS FOR BAKERY APPLICATION

Filip VAN BOCKSTAELE[1*], Marie ROMANUS[1], Benny LEWILLE[1], Ellen VERWEE[2], Andre SKIRTACH[2] & Koen DEWETTINCK[1]

[1] Vandemoortele Centre 'Lipid Science and Technology', Food Structure and Function Research Group, Faculty Bioscience Engineering, Ghent University, Ghent, Belgium *Corresponding author (filip.vanbockstaele@ugent.be)

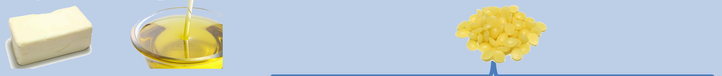
[2] Nanobiotechnology research group, Faculty Bioscience Engineering, Ghent University, Ghent, Belgium

1. Introduction & goal

Traditional fat ingredients in the bakery industry, such as shortenings or margarines, contain a high level of saturated fatty acids of which the intake has been associated with higher incidence of cardiovascular disease. Oleogels containing natural waxes as oleogelators have been investigated as alternatives to saturated fatty acids (SaFa). However, they appear to be shear-sensitive and high concentrations of wax may provoke a waxy mouthfeel. Combining natural waxes with common hardstock triglycerides may offer options for partial SaFa reduction. The goal of this study was to study the physicochemical properties of these hybrid fat systems to better understand the hybrid network structure.

2. Approach

Hybrid systems containing palm stearin (PS) – wax blends in rapeseed oil (RO) were produced. Wax concentration was calculated on RO based on CGC for each wax. Samples were mixed, fully molten and statically crystallized in a freezer till 15°C after which they were stored 24h at 15°C prior to analysis (DSC, PLM, Raman spectroscopy and texture). Crystallization thermograms of the hybrid fat blends were also recorded at a cooling rate of 5°C/min starting from 100°C.



Palm stearin Rapeseed oil Carnauba Wax Candelilla wax Berry Wax

PS **RO** **CRW** **CW** **BEW**

Critical gelling concentration (CGC) of wax in RO = CRW (4%) - CW (1%) – BEW (4%)

30% **PS** + 70 % [**RO** + wax (**CRW** or **CW** or **BEW**)] at conc: 0% / 50%CGC / 100%CGC / 150%CGC

3. Results

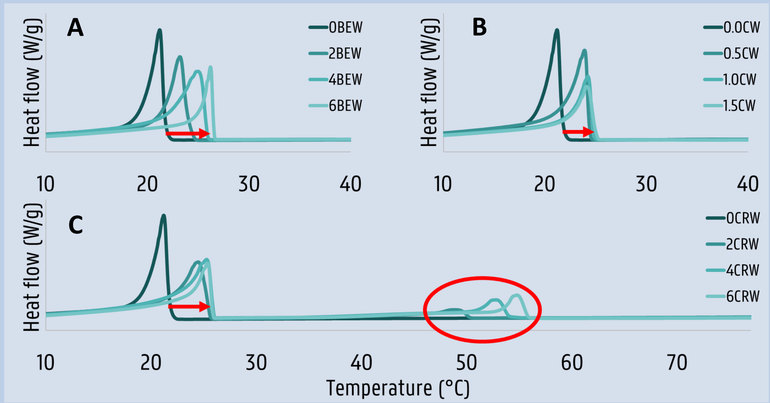


Figure 1: DSC crystallization curves at a cooling rate of 5°C/min of a hybrid system with 30% PS and different concentrations of berry wax (BEW: A), candelilla wax (CW: B) and carnauba wax (CRW: C) (% expressed on the oil phase).

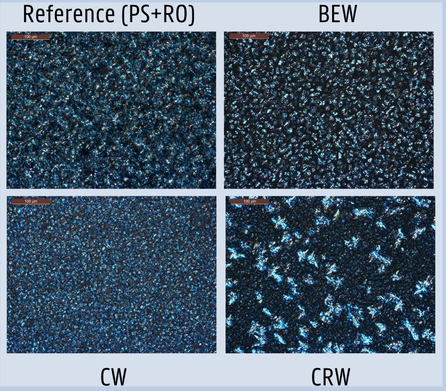


Figure 2: PLM of hybrid wax-PS mixtures of BEW, CW, and CRW at 150% of the critical gelling concentration (CGC) after 1 day of storage.

Addition of waxes provokes changes in crystallization profile, crystal size and network density. Crystallization onset temperature increases due to wax inclusion (Figure 1). Only for CRW a separate wax crystallization peak is observed. BEW and CW addition leads to smaller crystals and a denser network whereas CRW clearly shows a dual system with larger CRW crystals embedded in fine PS network. Raman spectroscopy (Figure 3) identified the presence of wax cores acting as templates for further PS crystallization.

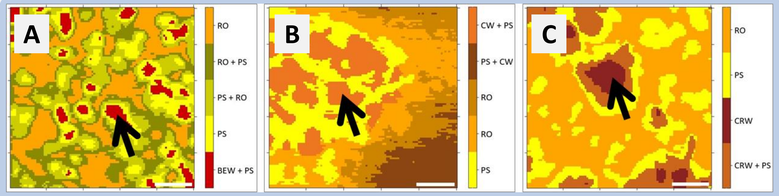


Figure 3: Identification of wax and PS crystals in 2D-images (100x100µm) obtained by Raman spectroscopy of a scanned surface of hybrid fat systems containing palm stearin (PS), rapeseed oil (RO), 6% berry wax (BEW) (A), candelilla wax (CW) (B) and 6% carnauba wax (CRW) (C). Scale bar represents 20 µm. Black arrow indicates the wax cores in the structure.

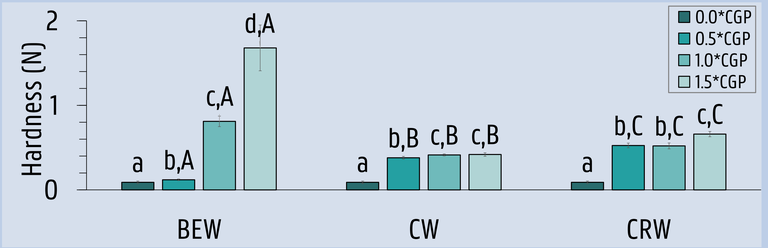


Figure 4: Texture of statically cooled hybrid wax (BEW, CW and CRW at 0-50-100-150% of CGC) – palm stearin (PS, 30%) systems in rapeseed oil (RO) measured after 24h at 15°C. Means (n=3) with different superscripts (a,b,c,d) within the same wax are significantly different (P < 0.05) and means with different superscripts (A,B,C) within the same concentration are significantly different (P < 0.05).

The texture of the CW and CRW wax-PS hybrid systems showed an immediate increase but acted rather wax-concentration independent. Contrary, berry wax only provoked a strong increase in hardness from the CGC onwards, and an increase to 150%CGC led to a doubling of the hardness indicating that the wax itself contributed to the texture of the system.

4. Conclusion

It has been demonstrated that waxes impact the properties of statically crystallized wax-PS-RO hybrid systems. Wax type and concentration impact the crystal network microstructure and texture. Raman spectroscopy was successfully applied to elucidate the role of the wax in the fat crystal network. Further investigation needs to focus on reducing saturated fat and the functionality of the hybrid systems.

GHENT UNIVERSITY

FACULTY OF BIOSCIENCE ENGINEERING

4TH FOOD STRUCTURE AND FUNCTIONALITY SYMPOSIUM
19–20 OCTOBER 2021, ONLINE LIVE AND ON-DEMAND
STRUCTURING FOODS FOR A SUSTAINABLE WORLD

Food Structure & Function

Vandemoortele
shaping a tasty future