



# Lipid domains in the milk fat globule membrane: the dynamics investigated in situ in milk in relation to temperature and time

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# Lipid domains in the milk fat globule membrane: the dynamics investigated *in situ* in milk in relation to temperature and time

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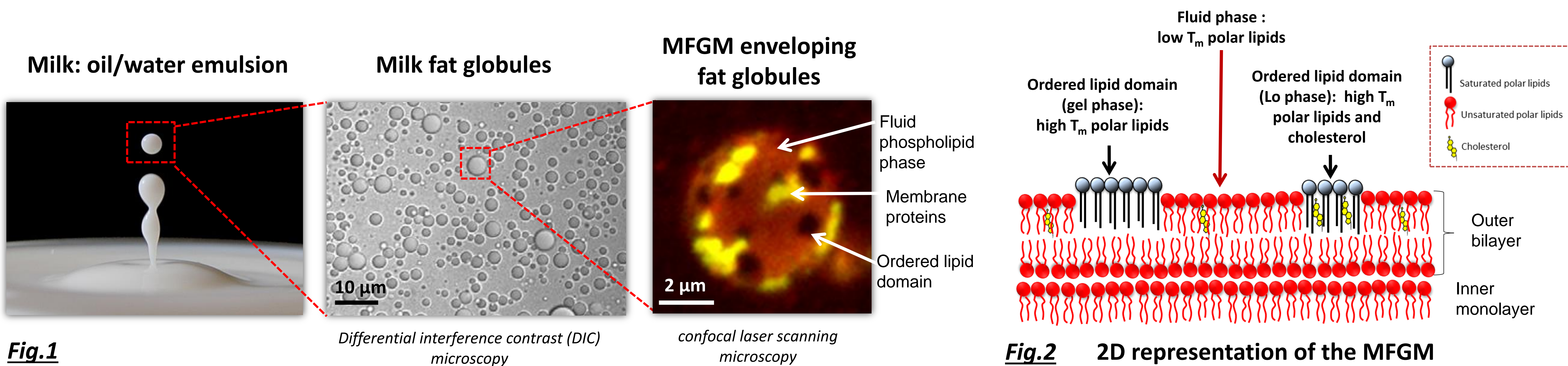
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## The milk fat globule membrane (MFGM)

Milk is an emulsion of fat droplets stabilized by a biological membrane called the milk fat globule membrane (MFGM; Figure 1). The MFGM is mainly composed of polar lipids that have different melting temperatures ( $T_m$ ), cholesterol, glycoproteins, and enzymes. The microstructure of the MFGM depends on the packing of polar lipids in the outer bilayer of the membrane that can lead to phase separation with formation of ordered domains (Figure 2). Milk is usually submitted to changes in temperature e.g. storage (4-7°C), churning (10-12°C) and heat treatments (e.g. pasteurization). Do these temperature variations and thermal history of milk affect the packing of polar lipids in the plane of the MFGM?

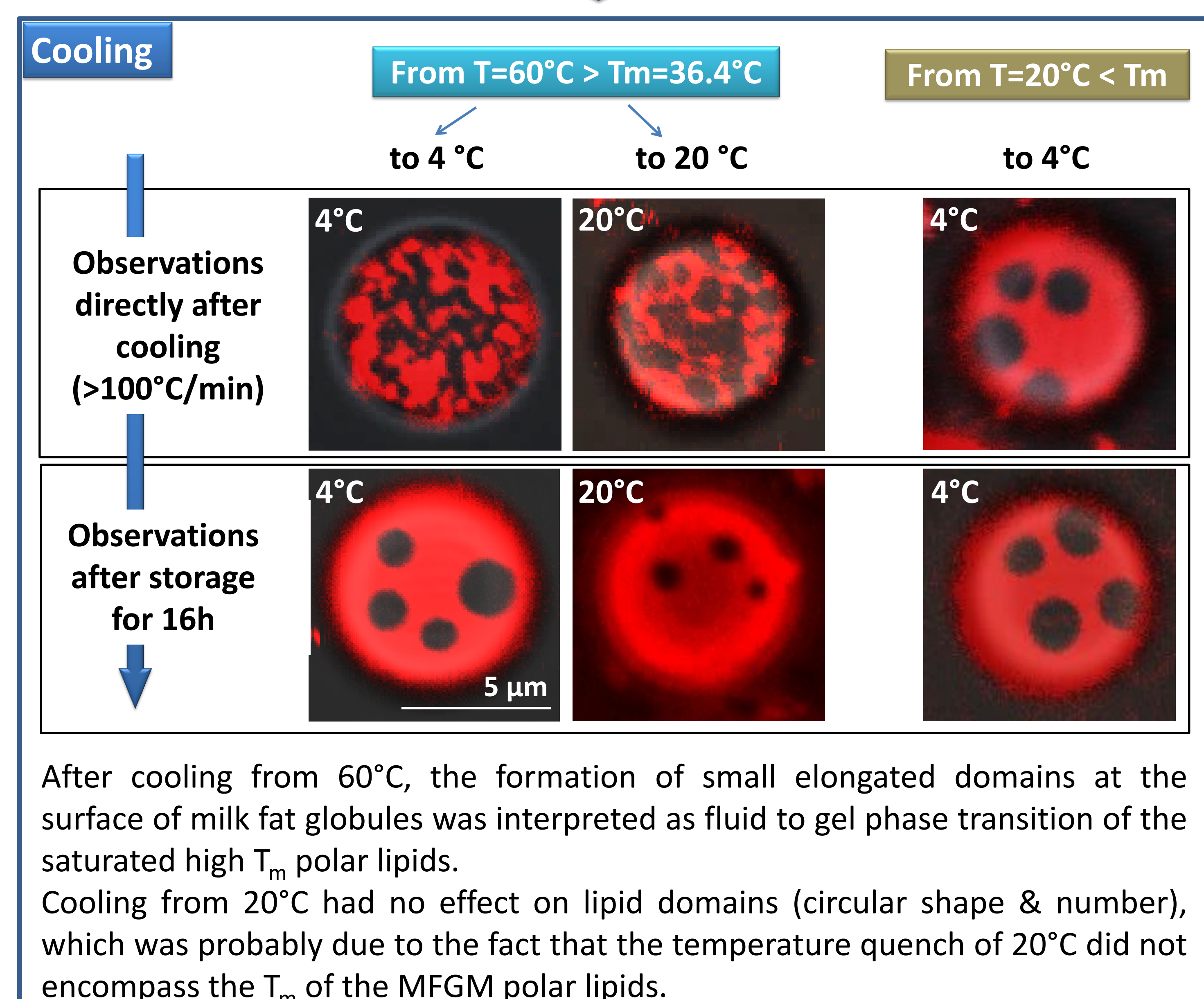
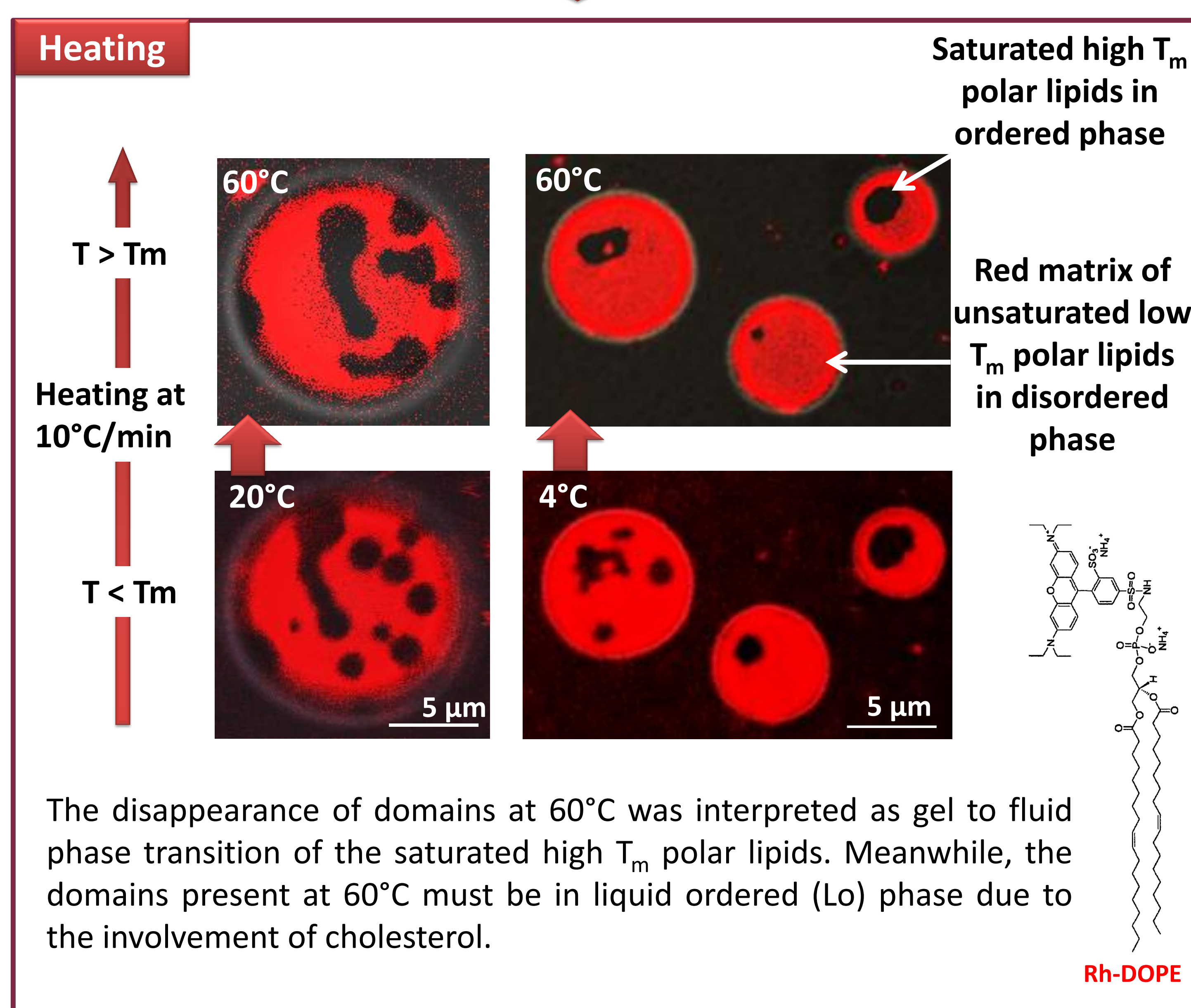
Experiments were performed by confocal laser scanning microscopy (CLSM) under temperature controlled conditions, using the head-labelled phospholipid fluorescent probe Rh-DOPE. Only the fluid phase of MFGM was labelled.



## Dynamics and reorganization of MFGM polar lipids investigated upon milk heating or cooling

Heating of milk favors the diffusion of the lipid domains, coalescence, reduction in size or complete melting of the polar lipids (disappearance of domains)

Rapid cooling of milk from 60°C favors the appearance of small elongated domains while extended storage induces lipid reorganizations within the MFGM with growth leading to large circular lipid domains



## Conclusion & Outlooks:

This study demonstrates that the packing of polar lipids within the MFGM strongly depends on the temperature and the thermal history of milk. Changes in the morphology and physical properties of the lipid domains induced by temperature and time could affect many interfacial mechanisms involved in e.g. lipid digestion, adsorption of enzymes, bacteria or viruses, localization of proteins, and could also alter the physical stability of fat globules during milk processing.

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