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Milk Fat Globule Membrane Proteomics: a “Snapshot” of Mammary Epithelial Cell Biology

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Lipids are released in milk as fat globules, which are droplets of apolar lipids surrounded by a complex membrane deriving from the mammary epithelial cell (MEC) and called the Milk Fat Globule Membrane (MFGM). Milk lipid synthesis initiates into the endoplasmic reticulum (ER) of the MEC by the budding of cytoplasmic lipid droplets (CLD). CLD then migrate to the apical pole of the MEC where they are progressively wrapped up by the plasma membrane to be released as fat globules into the lumen of mammary acini. The structure of the MFGM is thus highly complex and closely related to the mechanisms of milk fat globule biogenesis and secretion by the MEC.

We have recently characterized MFGM proteins in several species, including the goat, the horse, and the camel species. We have highlighted prominent differences with the bovine species, especially regarding lactadherin, a major MFGM protein. Recent technological breakthroughs in proteomics (primarily, the development of one dimensional-gel electrophoresis approach coupled to high resolution tandem mass spectrometry (1D-LC-MS/MS)) led to the identification of hundreds of proteins associated to the MFGM. Newly identified MFGM proteins are not only involved in lipid metabolic or exocytosis-related biological processes, but also in translation, or cytoskeleton organization. Identification of proteins in the MFGM will probably contribute to identify genuine partners of lipid droplets formation, growth and transit in the MEC and ultimately their release as fat globules in milk. In addition, the fact that the MFGM most likely reflects the mammary epithelial cell content and the emergence of quantitative proteomics will help to improve our understanding of biological mechanisms occurring in the mammary gland under different physiological or pathological conditions.