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Advances in Nutritional Strategies to Alter the Lipid Fraction of Ruminant Milk for a Healthier Life

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Milk and dairy products are recognized as important sources of nutrients in human diets. Milk lipids (3 to 5%) are present in the form of small droplets called milk fat globules emulsified in the aqueous phase (87%). This lipid fraction contains a core of nonpolar lipids (mainly triglycerides ; 98% ; source of energy) coated into the milk lipid globule membrane (**MLGM**) composed of polar lipids mainly phospholipids and minor specific proteins, and is considered as a source of bioactive molecules. Lipid-soluble vitamins (A as retinol and β -carotenes, D, E, K; $\sim 40\text{-}60 \mu\text{g/g}$ lipids) and xanthophylls must also be considered as high value micronutrients of the lipid fraction. Among fatty acids (**FA**) carried by triglycerides and phospholipids, some may exert negative effects (12:0, 14:0, and 16:0) when consumed in excess, whilst others have potentially beneficial effects (anteiso-15:0, cis-9-18:1, and 18:3 ω 3) on human health or putative positive effects as shown in rodent models (cis-9,trans-11 CLA). Over the last decade, numerous nutritional experiments have been carried out to enhance the milk fat content of a number of specific FA recognized as having beneficial effects on human health and to decrease those that may have detrimental effects. Moreover, the milk vitamin E and A (and β -carotene) content is affected by the nutritional state and amount and type of forage in ruminants. Lastly still little is known on effect of nutrition on the composition of lipid, and even less on protein, of the MFGM. Because nutrition is the main lever of the milk fat plasticity, the aim of this review is to report the recent data on the effect of diets on the milk lipid fraction of ruminants. We will also update data on the impact of diets on plasma lipid composition and mammary lipogenic and desaturation pathways that determine the milk fat composition. We will focus on recent data using new techniques of lipidomics and proteomics to identify the major and minor components of the lipid fraction and spectral methods to predict FA composition. Finally, we will pay particular attention to differences in the responses to certain nutritional factors of the milk fat content and composition in dairy ruminants, which offers an original model of study to decipher the underlying mechanisms.